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TALKING ELECTRONICS PRESENTS:

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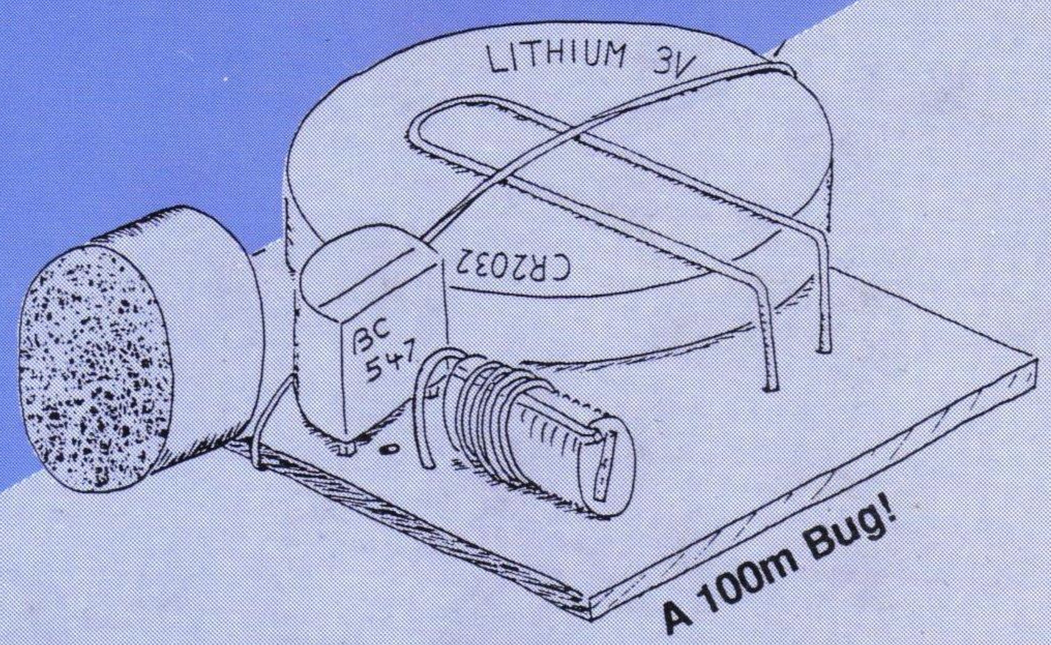
$4.95NZ incl GST

SECURITY DEVICES

by
Colin Mitchell
&
Staff

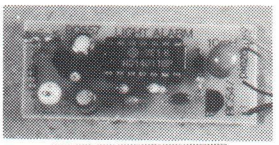


✶ Build a fully surface-mount Bug!

A TALKING ELECTRONICS PTY LTD
PUBLICATION

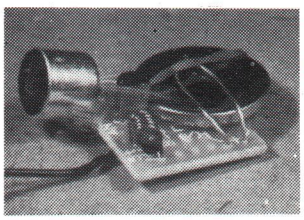
11 KITS TO BUILD!

In this issue you will find 11 new projects, designed to show you how security devices work.
To cover the full range of these will take a number of books and since some of them are very expensive to buy, ready made, the most economical way is to build them yourself.
Each book will present a range of circuits and I am sure you will find them all very interesting.
Note: the first price covers the parts and PC board. In other words it is the TOTAL price. If you want just the PC board or an extra board, its price has been shown also. I am sure you will be buying a few kits so here's the range for this issue:

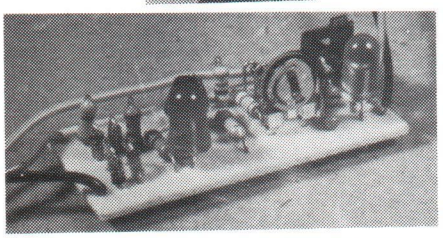


LIGHT ALARM
Parts & PC: $11.50
PC Board only: $2.50
Detects the presence of light. Can be used for fridges, drawers etc.

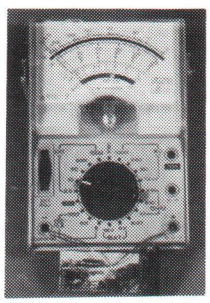
WOX
Parts & PC: $7.50
PC Board only: $2.50
A whistle-ON, whistle-OFF switch.



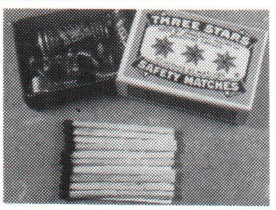
SPY BUG
Parts & PC: $19.00
PC Board only $2.50
Our fully surface-mount bug capable of transmitting about 100 metres.



PHONE ALERT
Parts & PC: $16.30
PC Board only: $2.00
Detects one or two phones on the line.

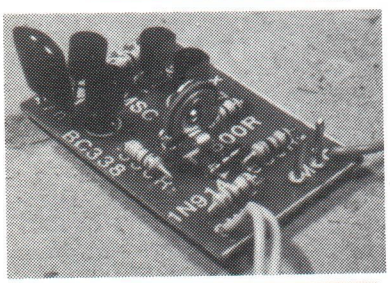


FIELD STRENGTH METER
Parts & PC: 8.70
PC Board only: $2.50
A piece of test equipment to test the output power of our transmitters.

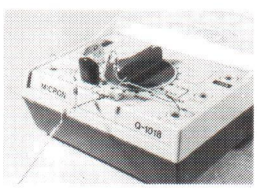


EARWIG
Parts & PC: $8.55
PC Board only: $1.70
An FM transmitter in a matchbox. Range: about 100 - 200 metres.

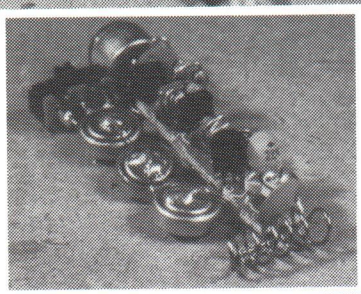
ULTIMA
Parts & PC: $12.50
PC Board only: $2.50
Our 1km bug. Requires LED Power Meter or Field Strength Meter to peak the output.



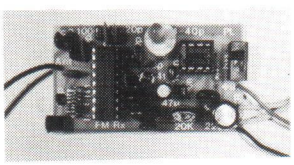
MOTOR SPEED CONTROLLER
Parts & PC: $9.10
PC Board only: $2.50
Reduces the RPM of a tape recorder motor without reducing the torque.



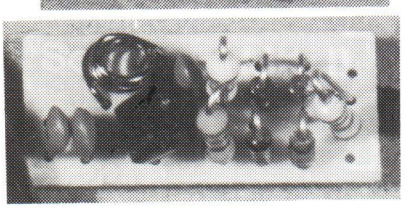
LED POWER METER
Kit of parts: $1.10
Used to peak the Ultima.



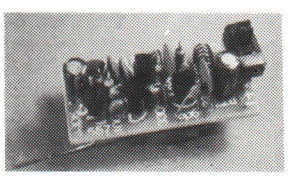
PEN BUG MkII
Parts & PC: $12.00
PC Board only: $2.50
Our improved Pen Bug project. Refer to the Pen Bug article in More FM Bugs ($3.35) for the construction details.



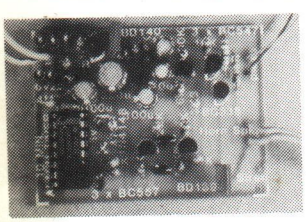
FM RADIO
Parts & PC: $21.95
PC Board only: $2.80
An FM radio using the TDA 7000 chip. Ideal for picking up our FM transmitters.



SCORPION MkII
Parts & PC: $35.00
The instructions for this project come with the kit. The circuit is copyright and cannot be presented in the magazine.



BEEPER BUG
Parts & PC: $6.90
PC Board only: $1.80
A transmitting beeper bug that can be used as a tracker.



10 MIN ALARM TIMER
Parts & PC: $13.30
PC Board only: $3.50
This project is added to the output of an old-style alarm to convert it into a 10 minute alarm. Has an inbuilt siren circuit.

TALKING ELECTRONICS Pty Ltd
35 Rosewarne Ave., Cheltenham, 3192.
(03) 584 2386

MasterCard VISA bankcard

Post & Pack $2.50 per kit.
Max. P&P $8.00

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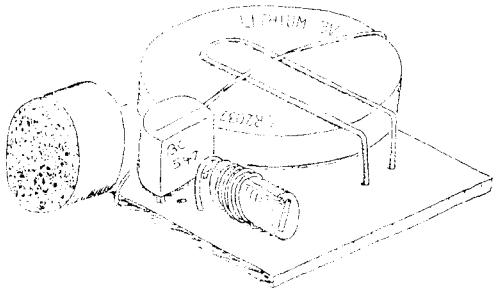

Our feature in this issue is a fully surface-mount bug. Read about it in the first article. Surface-mount is here to stay and this bug will highlight how small electronics is becoming.

Line diagrams: Darren Kilby
CAD diagrams: Paul Loiacono

Many of the projects have been designed by Richard Borg.

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* Recommended and maximum price only

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Cheltenham, Vic. 3192.
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A TALKING ELECTRONICS Pty Ltd PUBLICATION

EDITORIAL

by Colin Mitchell

As we get more involved in the security side of electronics, lots of new ideas have cropped up.

The demand for simple devices such as those in our previous 3 issues has been greater than expected.

Not only are we making the hobbyist aware of the need for security but the professional is becoming interested in our products too.

We have exposed the myth that small transmitters need be expensive, and beyond the capability of the hobbyist, and gone on to producing a range of devices that can protect the small business man, both in the office and in the field.

Maybe our products are too cheap, but how can we operate otherwise when our principle motto is to provide a service that cannot be beaten, including information and books at the lowest price.

Even so we get used.

Some readers only buy the PC boards and think they can pick up the parts in dribs and drabs from the local shop, at a price lower than our kit.

We see this in some of the projects sent in for repair with "odd ball" bits on the board.

Only once have we been used by a "Security" firm. They sent a kit for repair "under guarantee" - because they went by the instructions and it still didn't work!

They were very indignant about sending in the service fee and claimed it should be fixed under guarantee. By the quality of the soldering they should not be in business and it's fortunate that this sort of thing hasn't happened before.

At the other end of the scale we get the "high flier." Those entrepreneurs with grandiose ideas about being able to sell thousands and thousands of bugs.

The market just isn't big enough to support this. The biggest problem is getting to the consumer. Advertising is such an expensive way of reaching a target audience that our products could not be held at their present level if an advertising component were to be included.

However we will keep going as the sense of achievement outweighs the slow sales.

As a side issue, I read a comment from an engineer who should know what he is talking about.

He said 50,000 mini bugs like ours were sold in Australia each year. Statements like this make you wonder where he gets his facts from.

He also stated that built-up units such as the Amoeba and Voyager were readily available in sleazy shops in the inner suburbs for about $20! When challenged on this statement, he would not give further details.

This is the sort of mis-information that goes to press or is presented on current affair programs and the general public forms a totally inaccurate view of the scene.

The closest we got to a $20 bug was a King's Cross shop selling an "ANT" equivalent for $99. The single "N" cell model was supposed to travel 300 metres but was lucky to go 100 metres in ideal conditions.

MORE PROJECTS FOR THE SECURITY CONSCIOUS HOBBYIST

The one major mistake we made in the previous issue was our comment on the cost of a Pen Bug at $1200. We have found this to be inaccurate.

The bug doesn't sell for $1200, it's $3,200! I don't know how we could have made such a stupid mistake.

I have placed an order for 10 units because they must be absolutely fantastic.

Anyone wishing to buy one will naturally get a discount so let us know how many you want!

Another update concerns the supplier who accused us of copying some of his designs. Last week I was shown a book that contained his designs, almost to the letter. As an example, his phone tape in kit form costs $72.00! All the designs were so primitive that we didn't even read the book!

The projects were constructed on old-fashioned matrix board and were nothing like the quality of our Amoeba or Voyager. The kit prices in the US were 3 times ours, his were 6 times!

Before I go, I must warn you that some shops are selling our kits for up to 50% more than the recommended price in the catalogue. Even though this is not illegal, they get a discount at our end for buying in bulk so it's a bit steep to mark up an item at both ends.

If you haven't seen our three previous books, you will be out of luck. The first two have completely sold out and you will have to start with number 3, "BUGGING AND ITS PREVENTION."

Our intentions are to teach you in a step-by-step mode and this involves building simple projects and graduating to complex ones.

It is not in your best interests to be building something complex and not know how it works or how to fix it.

We want the learning curve to be gradual and that's why we ask you to stick by our rules.

One last thing.

I want to keep you up-to-date with the overseas venture.

To put it in a nut-shell, it has been a very expensive exercise that hasn't got off the ground yet.

Unless you are physically overseas on a permanent basis it is very difficult to organize something by remote control.

So far, all we have found out has been "what not to do!" And with this in mind we will have another launch next year.

In Australia, we are up with the 3 other commercial magazines and are only a "one-man show" with no advertising or gloss paper.

No-one beats us for sales figures or editorial content and we can't help being a success overseas. We just need a big break.

I know you will be following our venture.

So, now it's on to the projects.

We have presented another 7 in this issue and included a few updates on previous models.

Even if you are not into bugging, you will appreciate the capability of electronics to provide household and business security.

Many of the designs can be modified to suit your own particular need so don't overlook doing a little bit of designing yourself.

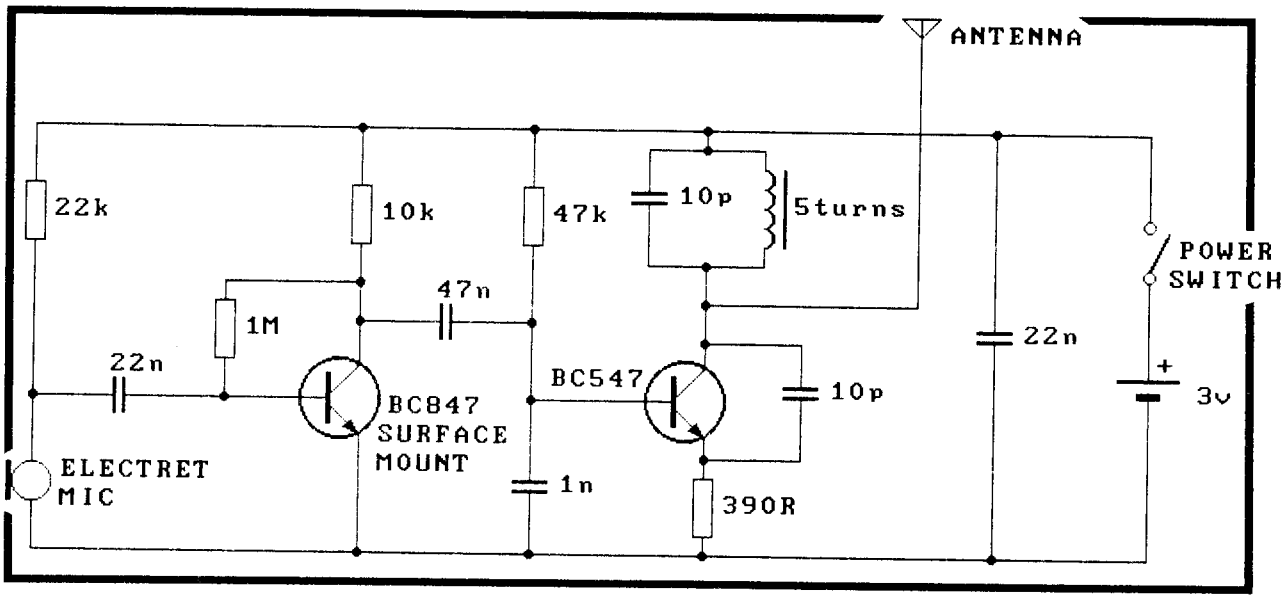
For instance, the Water Bug in the last issue can be redesigned to detect the absence of water in a channel or dam etc. Although neither design has been a runaway success the possibility for modifying is always present.

Lets' hope you find some of the projects in this issue will suit your needs.

TE's SPY BUG

Our smallest bug - 100metre range

Parts $16.50
PC board $2.50
Total $19.00
extra lithium cells $3.00



SPY BUG CIRCUIT

This must be the world's smallest bug to be presented in kit form. Smaller than a couple of 20¢ pieces stacked on top of each other, the circuit follows our standard two-transistor arrangement as seen in the Voyager, with the resistor values changed to suit the lower voltage and the capacitor values adjusted to suit those readily available in surface-mount form. It also employs a small electret microphone and a wafer-thin 3v lithium cell.

A surface-mount BC 847 (identified as '1G') has been used for the audio stage and a standard BC 547 for the RF stage as we could not get a surface-mount type to operate reliably at RF frequencies.

The final design reminds me of the "cube of sugar" bug I described briefly in a previous issue. The Sugar Bug was brought in for repair some time ago. At the time it was the smallest bug available on the market and sold for between $330 and $500 (depending on where you bought it!)

I can assure you, the performance of the Spy Bug is not only superior than the Sugar Bug, it's smaller!

At a casual glance the bug appears to consist of 5 parts: a battery, microphone, transistor, coil and PC board with a short length of hook-up wire. It's only after very close inspection that the surface-mount components can be detected on the underside of the board.

And that's the way we want it to be.

Show the bug to anyone not familiar with the capabilities of electronics and they won't believe something this small is capable of transmitting with such clarity over a range of 100 metres or so.

Before I go into the design of this project, I must make one stipulation. It's not for the beginner. It uses chip components (including a chip transistor) and requires a fair degree of skill in construction.

This is the fourth bug in a series of FM transmitters and you should build some of our previous models, such as the Ant, Amoeba or Voyager, to gain experience in construction.

The aim of this series is to bring you in line with modern technology while building something worthwhile.

Many of the technical features we have described in previous articles also apply to this project and it is an improvement over the previous bugs by having surface mount components and a ferrite inductor to allow the frequency to be set via a screw-driver, to between 70MHz and 110MHz.

This is the first time we have incorporated a slug (in our case a slug is a length of screwed ferrite material) in the inductor (an inductor is a coil of wire) and you will be able to compare the effectiveness of a slug tuned coil over an air cored coil.

PARTS LIST

1 - 390R (marked 391)
1 - 10k (marked 103)
1 - 22k (marked 223)
1 - 47k (marked 473)
1 - 1M (marked 105)

2 - 10p surface mount
1 - 1n surface mount
2 - 22n surface mount
1 - 47n surface mount

1 - BC 847 surface mount '1G'
1 - BC 547 standard pinout
1 - electret mic
1 - 20cm length .5mm enamelled wire
1 - ferrite slug 2.6mm x 6mm
F29 material
1 - 1cm x 4cm mylar strip for switch
1 - 5cm tinned copper wire
1 - small elastic band
1 - 5 cm x 3.5 cm wide heatshrink
1 - 3v lithium cell
1 - paper clip for holding components
1 - 60cm hook-up flex for antenna
1 - 30cm length .7mm solder
1 - **SPY BUG PC Board**

In the air cored design of the Ant, Amoeba and Voyager, the frequency was adjusted by squashing or separating the turns of the coil. When the coil is stretched, the effective inductance is reduced and the frequency of the tuned circuit increases. When the turns are squashed together, the inductance increases and this means the coil will deliver more energy to the capacitor. The capacitor will take longer to charge and thus the frequency of the circuit will decrease.

When adjusting the frequency, it only requires a very slight movement of the turns to get a shift of 1MHz or more. Some constructors found this very touchy and wanted a "fine tune" arrangement to set the frequency exactly.

This was one of the limitations of our previous designs and has been overcome to a certain extent by the slug tuning arrangement.

The reason why we have not concentrated on setting the frequency exactly is due to the shift that occurs with these simple bugs as the battery ages.

The frequency of transmission depends partially on the supply voltage as well as a number of factors including the loading effect of the antenna.

Thus any advantage of fine tuning can be swamped by the general drift due to these other influences.

The Spy Bug fits into the category of "Place and forget." These are bugs that are intended to be placed "in-situ" and not moved. The circuit is not classified as "tight" and the frequency will drift if it is touched or handled. It is not intended to be dropped into a handbag or pocket and in a later project we hope to have a more sophisticated design for this purpose.

The short-term stability of the bug, however, is exceptional and once the frequency is set it will not fluctuate or drift unless the antenna is touched or the supply voltage falls appreciably.

To cater for those who have asked for an easily adjustable bug, we have provided the slug tuning arrangement.

When a piece of ferrite is introduced into a coil it has the effect of concentrating the lines of magnetic flux. In other words it is capable of storing more magnetic energy than the same volume of air and this gives the coil greater inductance.

With this, you will be able to understand the next point:

When a slug is introduced into a coil in an oscillator circuit, the frequency will decrease. If you wish to increase the frequency to the original value, the tuning capacitor (the capacitor across the inductor) must be decreased.

Maximum inductance is obtained when the ferrite is in the middle of the coil and equal amounts protrude from each end. If the slug is screwed in either direction the inductance decreases and the frequency of the circuit increases.

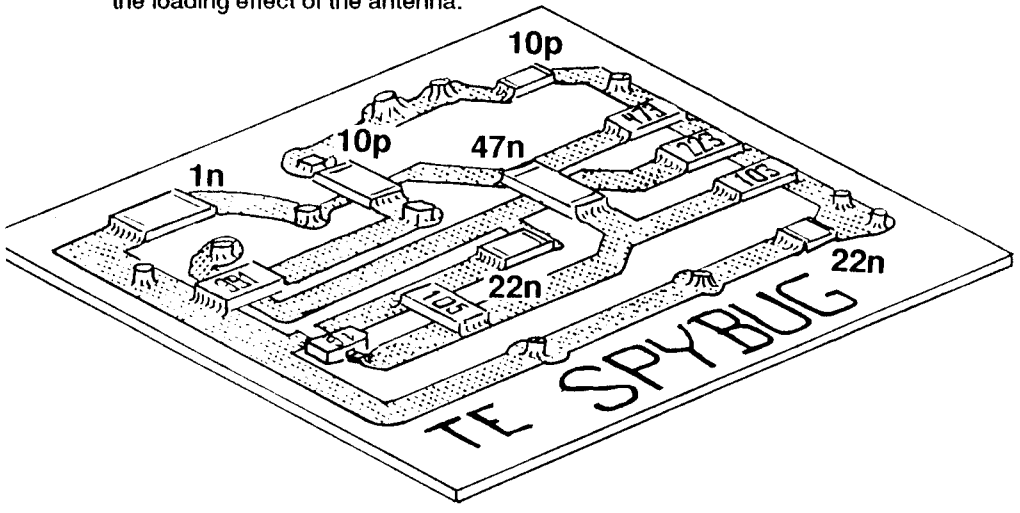
This means the slug should be positioned slightly off-centre when setting up the circuit so that the frequency can be increased or decreased as required.

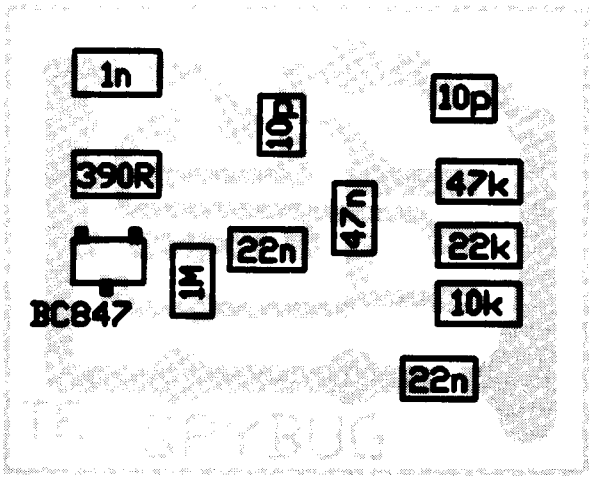
Ferrite slugs are very brittle and should be adjusted with a plastic screwdriver or non-ferrous material. The best way of making an adjusting tool is to file a plastic knitting needle into a screwdriver blade that will fit the small slot on the end of the slug.

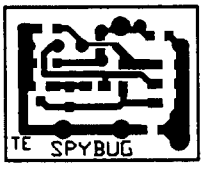
Plastic knitting needles are quite strong and with careful use will not break.

Jewellers screwdrivers are ok but tend to chip the slot in the slug and the presence of the metal will change the frequency of the circuit.

Our tests showed that the slug tuned coil improved the output about 25% and this is due to the "Q" factor of the ferrite. You may be expecting a Q value of 100 or more but as the frequency of a circuit increases, more energy is lost in the core material. We are operating at the upper limits of the ferrite and also drawing most of the energy from the circuit via the antenna. Thus we are not allowing the full effect of the ferrite to be realised.







Enlarged view of the underside of the board to show the placement of the surface-mount components. The trackwork above is the actual size you will be working on!

THE SURFACE MOUNT TRANSISTOR

Now let's talk about the surface mount transistor.

When you open up your kit of parts you will get quite a shock.

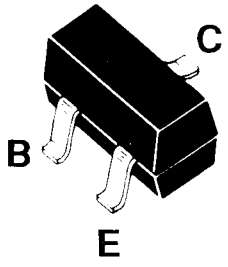
The surface mount transistor is smaller than you think and in fact I think it is too small for manual insertion. But that's what you'll have to face.

Certainly the designers of surface mount transistors had no intention of them being inserted by hand as they are smaller than a surface mount resistor!

But prototypes will have to be assembled by hand and this project will be good experience for later.

Below you will see the outline for the surface mount transistor. The top of the device is too small to fit the full type number and a silly code number has been allocated as follows: BC 847

(NPN) is marked 1G. This is the same as BC 547. The tiny leads are so short that they just emerge from the case and this means any heat from the soldering iron will travel to the junction very quickly. You have only half a second to complete each solder joint. Any delay will damage the transistor totally and it will fail to amplify.



THE FUTURE OF SURFACE MOUNT

Electronics is advancing faster than you can imagine.

Computers currently have a life of about 1 year!

We have witnessed the mass destruction of whole mother boards that are just 2 years old, being dumped at a scrap dealer.

Just an odd lot you may think. He had tons of PC boards!

It's not until you visit a computer graveyard that you appreciate the advancement of technology.

To give an example: A 10 year old 1Meg hard drive from the US weighed 15kgms! The PC board was 40cm x 40cm! Even a 5 year old drive was massive and contained no surface mount technology at all.

Today's drives are fully surface mount and contain special controller chips and very large scale integration to not only shrink the board but increase the capacity to unheard of values.

But its not only computers, cameras, videos, space craft and microcassette players but the humble TV and radio that has the new technology.

Surface mount is taking over everywhere because it's cheaper, once the cost of "pick and place" machinery has been absorbed.

The reason is simple. Surface mount PC's are smaller and cheaper, the parts are placed at a higher rate and the finished product is miniature. Thus it has an edge on the market.

This means normal components will be off the shelves very soon as the hobbyist market and service area represent less than .5% of sales.

Sad as it may seem the writing is on the wall. Leaded components will be a thing of the past as new technology is taking over at about 15% per year.

Surface mount is the key to the future and unless you think and design in surface mount, you will be left behind.

The PC board for this project has been designed on a CAD package and once you know your way around the controls, the time you can save is incalculable.

But enough of this, let's get back to the project and see what I am talking about.

HOW THE CIRCUIT WORKS

Sounds are picked up by the electret microphone and its output is heavily dependent on the current supplied by the feed resistor (load resistor). The microphone supplied in the kit is a high sensitivity device and will produce very good results.

As you will have learnt in our previous discussions on electret mics, they contain a Field Effect Transistor and a sheet of very thin mylar material that has been charged during manufacture and will hold this charge for the life of the device. These are the only two parts in the unit!

Sensitivity is a result of controlling the charge on the mylar film and a sensitive device will detect sounds better than the human ear. The only problem with high sensitivity devices is the generation of background noise and if too much gain is attempted, this noise can be quite disturbing. Microphone gain is achieved by lowering the the load resistor.

In our circuit we have struck a balance between the two while achieving a result that can pick up whispers at 3 metres.

When the microphone is in circuit, a small voltage will appear across its terminals and the current flow will be as low as 100 microamp. The FET inside the case does all the work and its gain could be as high as 100, 500 or even 1,000 - we have no way of determining this except to say the output is very high for the sound pressure being picked up.

The output will be less than 1mV for a faint sound and about 30mV for a loud whistle at 1 metre and the output is passed to a single audio stage.

This stage has a gain of about 50 - 70 and the output is fed into the base of the RF oscillator via a 22n capacitor.

The oscillator is a standard Hartley type with the tuned circuit in the collector.

The secret of the operation of the RF stage is the transistor must switch off for part of the cycle so that the resonant circuit (the coil and capacitor) can provide a waveform that is basically a sine wave.

This waveform can be larger than the supply and the phenomenon will be covered later.

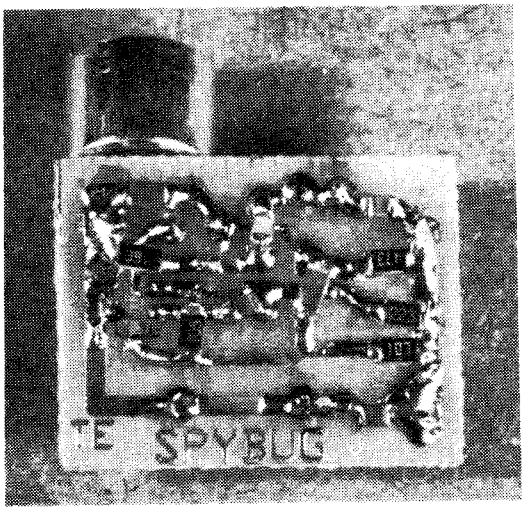
The importance of the tuned circuit is to set the frequency. The transistor is capable of operating at a very high frequency and we require a component or set of components to set the frequency to about 88MHz. In essence, the 10p and 5 turn coil does this. It sets the frequency by taking time to transfer the electromagnetic energy stored in the coil, to the capacitor. While this transfer is taking place, the transistor is switched off by the 10p connected to the emitter. How it does this will be explained later.

The fact that such a small capacitor can be used to do this is due to the high frequency of the circuit.

When the transfer of energy is complete (or nearly complete) the transistor switches ON again and both the tuning capacitor (the capacitor across the coil) and transistor, supply a burst of energy to the coil.

The 10p connected to the emitter assists by transferring the change in voltage (at the collector), to the emitter and turning the transistor ON.

Let's look at how the 10p does this:



A close up of the underside of the board to show the placement of the surface-mount parts. The transistor is the most delicate component and must be soldered very quickly to prevent damage.

A transistor is turned ON by increasing the voltage between the base and emitter. In our circuit, the base is effectively held at a constant voltage by the 1n capacitor. At the frequency of operation, the 1n holds the base very rigid and thus the transistor is not turned off by altering the base voltage.

Instead, the emitter is allowed to move up and down and this causes the transistor to turn on and off. The 10p between the collector and emitter does this.

The frequency of the circuit is set by adjusting the ferrite slug in the coil. This adjusts the inductance of the coil and determines the amount of energy stored by the inductor.

As the slug is screwed out of the coil, the inductance is reduced and thus the time it takes to transfer this energy to the capacitor is reduced. The net result is the frequency of the circuit is increased.

The antenna is connected to the active end of the resonant circuit and some of the energy is passed into the antenna for radiation to the surroundings. This is the energy we pick up on a receiver.

Not all the energy can be removed as this will kill the circuit and so a short fine wire is used for the antenna to limit the transfer. The 22n across the power rails serves an important function of maintaining stable rails so that the transistor can turn on and off fully.

We have used a thin 3v lithium cell to create the smallest bug ever and this cell has more than 5 times the energy of an equivalent "dry cell".

Here's a good way to compare capacities. A 9v transistor battery of the standard "dry cell" type has a capacity of 150mAhr per cell. The alkaline version has 550mAhr and the latest lithium design has 1200mAhr. Each cell in this new lithium battery weighs 10gm making the energy/weight ratio 120mAhr per gram. The lithium cell used in our project weighs 3gm so let's say it has a capacity of 240mAhr, to be on the safe side. If the circuit takes 2.5 - 3mA, the life of the cell will be about 80 hours.

The on/off switch is fabricated with a strip of mylar. When the strip is pulled out, the bug is turned on.

As we have said, the circuit will operate for about 80 hours on a single lithium cell and to replace the cell, the heatshrink must be removed.

A new cell is then fitted and the bug re-heatshrunk for another 80 hours of monitoring.

SLUG TUNED COIL Vs AIR CORED COIL

Many constructors of our FM transmitters have requested a variable frequency so that they can tune the bug into an unused portion of the band.

Some wanted it to sit between radio stations while others wanted to be at one end of the band or even slightly off the band.

This project allows any frequency between 70MHz and 110MHz to be selected. Firstly you must decide which end of the band you wish to use. For the low end, use 6 turns and for the high end use 4 turns.

Screw the slug into about 3 turns of the coil and you will be able to tune about 10MHz across the band when the slug is adjusted with a plastic screwdriver as described previously. But the question at the moment is: What is the advantage of the ferrite coil over an air cored coil?

In practical terms we can say the improvement is small. Our tests showed an increase of about 20% - 50% in output power but the overall performance was little better than the ANT due to the size of the lithium battery being smaller than 2 AAA cells and thereby not providing as large a ground plane.

Theoretically, the energy that can be stored in ferrite material is up to 100's of times greater than air but as the frequency of the circuit increases, the losses in the ferrite increase too.

For this reason, high frequency ferrites are available but at 90MHz, the losses start to approach the "quality factor" (Q factor) of the coil.

At a lower frequency the introduction of a ferrite material may increase the performance 1,000% or more whereas our tests showed an improvement of only 120% to 150%.

We have explained that the inductance of the ferrite coil is about 5 times that of an air cored coil and this means the tuning capacitor must be reduced accordingly.

The main advantage of a slug tuned coil is the ease of changing the frequency. This is especially important in countries like the US where the FM band is already crowded and to find a blank spot on the dial requires careful tuning.

A ferrite inductor can be made much smaller than its air counterpart due to it being able to store a higher flux density.

Finally, a ferrite inductor is not as susceptible to outside capacitance effects as an air inductor as the magnetic flux is contained within the coil.

THE SWITCH

To save space, an ingenious switch arrangement has been used.

The idea came from a musical card in which the opening and closing of the card pushed a thin strip of plastic between two contacts to turn the chip on and off.

In our arrangement a piece of mylar is placed between the negative of the cell and a contact on the PC board. When the strip is pulled out, the bug is turned on.

During construction, you should be aware of how the switch operates and make sure the cell is pressed against the contact so that reliable operation will take place.

Tinned copper wire over the battery connects the positive terminal of the cell to the board and the force of the mini elastic band maintains contact.

ABOUT THE PC BOARD

There's more to designing a PC board than meets the eye, as we found out.

The Spy Bug project was designed on prototype board using surface mount components and short joining wires. It worked very well so we transferred the design onto artwork via a CAD system and because we were in a rush, we had 1,000 boards produced.

When we got them back we built up a sample and found it did not work nearly as good as our original.

This was due to the trackwork being slightly different and the circuit had lost its "tightness."

Because of this we had to scrap the 1,000 boards and start again. This time we tightened up the layout and shortened all the tracks.

Being cautious, we had 10 prototypes made.

The drill file clearly indicated which holes were to be drilled but the PC man decided to drill everything by hand!

You guessed it. He drilled all the "do not drill" lands and left the holes to be drilled untouched! Human intervention!

We drilled the correct holes and built them up. They all worked very well (apart from being riddled with holes) and we will go ahead and get a production run organised next week.

Hopefully the boards will be right!

Final tension will be provided by the heatshrink but this should not be added until the project has been checked and tested.

WINDING THE COIL

The coil is wound on a ferrite slug and must be done neatly and as tight as possible as the slug is required to screw in and out of the coil to adjust the frequency.

The slug must not be allowed to rattle or move by itself as this will cause the frequency to drift.

When using the Spy Bug, the slug will protrude from one end of the coil so that screwing the slug into the coil will lower the frequency and screwing it out will increase the frequency.

For the moment, the job is to wind the 5 turns neatly on the slug. To make it easy, start in the middle of the slug and start winding.

The turns are wound in a clockwise direction and to make sure you are winding in the right direction, check with the holes on the board. If you run out of former, screw the slug into the coil and continue winding.

"Five turns" is determined by 5 loops of enamelled wire at the top. Straighten the ends of the wire and cut them off at 1cm. Scrape the ends with a razor blade or file to remove the enamel coating and tin the ends with a soldering iron.

Unscrew the slug so that one end is flush with the coil. It's now ready for soldering to the board.

Make up a tool for screwing the slug as mentioned previously and make sure the slug is able to turn without damaging the slot in the end. Ferrite is very easily chipped or cracked and once it is cracked you will not be able to turn it in the coil.

SOLDERING

Most of the skill in getting this project to work lies in careful soldering. The surface mount transistor can be damaged by excess heat as can the surface mount resistors and capacitors.

The only acceptable soldering iron is a 10 watt to 30 watt type or a soldering station.

Any of the instant-heat irons such as Scope, Birko, Pronto, battery or gas types will not be suitable. They all get too hot and it is impossible for you to judge the correct operating temperature.

You must also have the right solder - fine solder.

Don't fool yourself. A clumsy iron and thick solder are only a waste of time. Even I could not solder a surface mount component with an instant heat iron and thick solder.

All these irons have been banned from our workshop for years. If you damage a resistor, you can measure it, but how are you going to measure a 10p capacitor?

Be safe and not sorry. Get the right iron and solder to suit.

We will not be offering a repair service for anyone who has obviously not conformed to our suggestions. Any poorly constructed projects will be returned as we don't have any more than a few minutes to spend on any particular repair.

Next you should look at the range of tips and pick the smallest type available. The best is one that gradually tapers to a point as it will allow you to work in tight places.

Don't think you can file an old tip to a point as it must be plated to prevent pitting, wearing and allow it to accept solder.

In short, a good soldering iron is essential and will improve the finish of the project 100%.

If the bug doesn't work, the first thing to suspect is poor soldering, resulting in a damaged component and this will be very hard to locate if you have made a mess of the job.

When you have the right iron, fine solder and the necessary tools such as cutters, paper clip (for holding the surface mount components) etc, you can start construction.

CONSTRUCTION

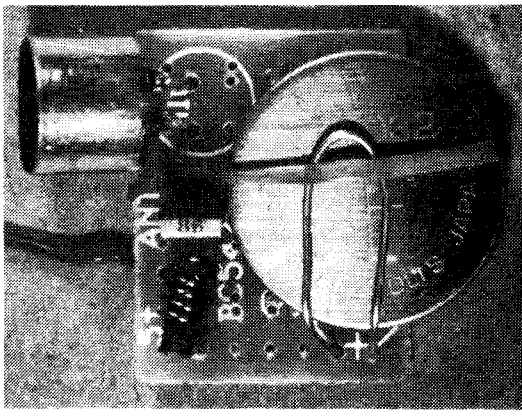
Clean a space on the workbench and open the kit of parts.

All the surface mount components are housed in a carrier strip and these must not be removed until each is required. They can easily be lost and the capacitors are difficult to recognise as they are not identified.

Size is not always an indication of capacitance as some are single layer devices while others are multi-layer.

The only way is to measure them on a capacitance meter or take our word for it. We have placed them in a carrier strip in ascending order to prevent any mix-up. A black band at one end of the carrier indicates the lowest value and the capacitors are: 10p, 10p, 1n, 22n, 22n, 47n. The resistors are next and are marked: 391, 103, 223, 473, 105.

Start with the surface mount components and begin with the 10p capacitor next to the black band on the carrier strip. Refer to the diagram of the underside of the board and place a small amount of solder on the two lands for the 10p.



The PC board manufacturer drilled all the wrong holes in the prototype. Hopefully he will ge the production run correct!

Take the capacitor out of its carrier and sit it on the board in the correct position.

Hold it in place with the paper clip, that has been opened out to act as a probe.

Soldering the component in place is really a re-flow process. You don't add any more solder but heat up the solder that is already present.

Repeat with the other end, keeping slight pressure on the chip with the paper clip.

Both ends are soldered very quickly and the component sits neatly on the board with surprisingly little effort.

Continue with the next value, making sure you know exactly where it is to go before starting.

Follow through with the capacitors and resistors until all have been added.

Finally we come to the surface mount transistor.

With the speed and skill you will have gained in soldering the caps and resistors, you can add the transistor without fear of damaging it.

Make sure you prepare the three lands with a small amount of solder on each. Position the transistor over the lands and hold it in place with the wire probe. You can also use a very small amount of Blue Tac on the end of the wire to transfer the transistor to the board and hold it in place.

Solder each lead quickly and the worrying part is over.

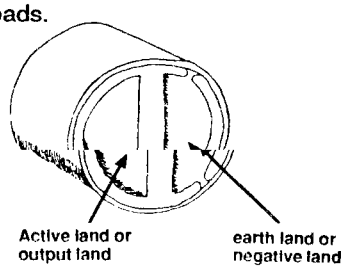
The only parts remaining are the output transistor, coil, microphone, antenna and fitting the 3v cell.

These are all easy to fit and the next item we'll add is the electret mic.

THE MICROPHONE

Two types of electret microphone may be supplied in this kit. Both are electrically the same but look different.

The small electret is a 2 leaded type and has two solder lands on the back to take 2 leads.

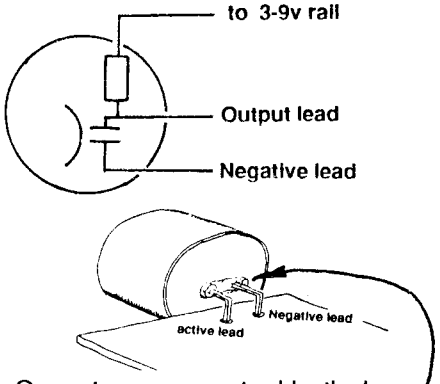


After inspecting it very carefully you will see one land connects to the case and this is called the EARTH or NEGATIVE land. The other is the ACTIVE or OUTPUT land. Refer to the accompanying diagram to see how the microphone is connected to the PC board.

Solder two short lengths of tinned copper wire to the lands and note which goes to the case. This is the negative lead and must be fitted down the negative hole of the board.

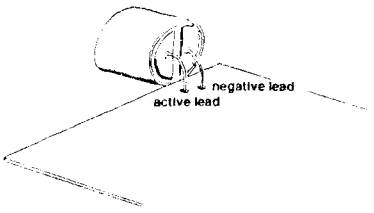
Push the leads down until the mic rests on the PC board or keep it up high and bend the unit to 90° as shown to make a more professional arrangement.

Solder the two leads quickly to prevent them desoldering from the microphone. If you have the larger 2-leaded microphone (I say 2-leaded microphone because 3-leaded types are available and have an inbuilt load resistor to connect directly to a 3 - 9v supply. These can be converted to 2-leaded types by using the negative lead and output lead).



On our type, you must solder the large tab to the negative lead as shown in the diagram to make it into a shielded two-leaded type.

You now have a negative lead and an active lead and can solder the microphone at right angles to keep the board as compact as possible.



Next fit the output transistor so that the flat side is towards the coil. The holes in the board will guide you.

The coil is easy to fit and should be ready with the leads tinned, as described previously. Make sure the slug is protruding out of the coil so that the frequency can be changed during the setting up procedure.

All that remains is to solder the negative contact to the board. This is a short length of very fine wire taken from the antenna lead, fitted down two holes on the board and soldered in position.

Cover it with the mylar strip and place the lithium cell in position under the tinned copper wire and keep it in place with the elastic band.

Lastly the antenna is soldered to the antenna point on the board and the job's done.

You can now try the bug by pulling out the mylar strip so that the negative terminal makes contact with the fine wire and adjust the slug with your fingers until a feedback whistle is detected on a nearby FM radio.

Many of our readers say their bugs work first go and we plan it that way.

We have already built many models of each bug before we offer it in kit form and the bugs (sorry!) are already ironed out.

If you don't get a feedback whistle, go to the If It Doesn't Work section. If you get a whistle, you can add the heatshrink as shown in the photos so that it keeps the cell in place and protects the components from damage.

We have supplied special low temperature heatshrink and you can use a hair-dryer or candle to shrink it in place. Don't use too much heat as this will only damage the plastic.

A "TIGHT" CIRCUIT DEFINED

We mentioned the word "tight" in our introduction. Here's some further notes:

"Spy Bug" has been designed to be placed 'in-situ' and left to transmit. It should not be moved around or handled like a wireless microphone as the circuit has been designed for high activity and high output, not "touchability."

If stability when handling is required, the circuit would need to be "tight" and by this we mean the oscillator must be a low amplitude arrangement so that it is not affected by outside capacitance.

To further improve stability, the antenna should be decoupled from the oscillator with a buffer transistor so that the varying loading effect of the antenna does not alter the frequency of operation.

Refer to the Ant circuit to see how this buffering is achieved.

In a future design we will incorporate a stable oscillator with high output and achieve a bug called a "drop in."

These bugs are designed to be dropped into a pocket or handbag and allowed to monitor events while being carried around.

A big burly bloke came into our office some weeks ago claiming to be from "high up" and wanted 400 "drop ins." He said they used 400 last year and lost the lot. He said he would be back next week with a sample. We didn't hold our breath. He hasn't been back!

Maybe he's waiting for our drop-in bug to be presented in kit form!!

A CIRCUIT AT RESONANCE

Another statement we made was the amplitude of the oscillator could be higher than the supply voltage.

In a parallel tuned circuit, such as we have in the Spy Bug, the amplitude of the waveform can be theoretically very high. The size of the waveform is due to the quality of the material in the inductor and the speed with which the energy in the inductor is allowed to collapse.

In our case this voltage is reduced by the loading effect of the antenna and the voltage peaks flow into the antenna to be radiated as electromagnetic energy.

Three pages have been dedicated to this in More FM Bugs (P. 11, 12 and 13) and is essential reading.

IF IT DOESN'T WORK

If the circuit doesn't work, you have 3 options.

1. Try to fix it yourself,
2. Send it in for repair or
3. Put it aside and build another kit.

The third option is not as silly as it sounds.

With the next kit you will take more care and the chances of it working will be greater.

You can then compare the parts and layout of the non-working model with the model that works.

This project provides a fair degree of challenge as the components are very small and some of them (the capacitors) are not identified. The size of a surface mount capacitor does not indicate its value but since there are three different sizes and you can use the process of elimination to determine the values.

Fortunately there is a simple test you can make to separate the circuit into two halves - the RF section and the audio section.

Using the Field Strength Meter or LED Power Meter (described in the Ultima article in this issue), you can determine if the oscillator section is working by connecting the antenna point to the meter.

If RF is being produced you will get a deflection on the meter and you can now test the audio section by positioning an FM radio about 2 metres away and adjusting the ferrite slug until a carrier or squeal is detected on the radio. If the background noise disappears but no squeal is produced, the RF section is working but the audio section is not.

Checking through a surface mount project is much more complex than a standard project as the surface mount components are easily damaged during soldering - especially when soldered by a hobbyist!

Once you have the project ready for testing, check all the components to make sure they are in the correct positions.

This is especially important with the capacitors as they are unmarked and you can only go by the fact that there is one 1n, two 10p's, two 22n's and one 47n.

Next measure the resistance of each resistor, with a multimeter. The bug should be off during this operation. If you get an incorrect reading, reverse the probes and try again. All the resistors should read their correct value. An open resistor will be very easy to detect and is quite on the cards. The end terminations can easily break from the resistive substrate during soldering. If this is the case, you can buy another pack of resistors to replace the faulty part or parts.

The capacitors are more difficult to test and I would venture to say that I would not trust checking them with a capacitance meter while they are in circuit - especially the 10p capacitor, as the surrounding components will influence its value appreciably.

On the other hand it will not tolerate being removed from circuit, tested and replaced.

So we have a dilemma. My choice is to move to checking the current (2.5 - 3mA) and testing the voltage at all points on the circuit. Use the low range on the multimeter to measure these.

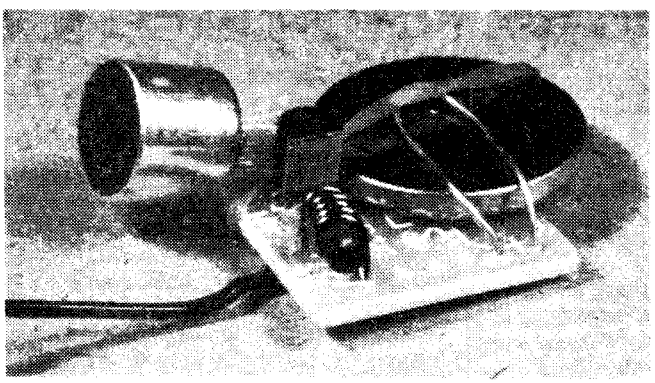
Next measure the voltage across the 390R (1v) and the voltage on the base of the RF transistor (1.65v). This will show the transistor is turned ON and if no RF is being produced, we can conclude the stage is not oscillating. This could be due to the transistor being faulty; the 10p being open circuit; the 1n on the base being open or the 22n across the battery being open.

RF is detected by using the Peaking Circuit or LED Power Meter (as mentioned in the Ultima article) connected to the collector of the RF stage and any movement at all on the multimeter will show that RF is being produced.

Once you are satisfied RF is present, you should adjust the ferrite slug to get either a squeal or blank spot on the radio.

This will bring the frequency of transmission into the 88 - 108MHz band.

If only a blank spot is detected, the audio stage is defective and will require checking the surface mount transistor and its associated components, as well as the electret microphone, load resistor and 22n coupling capacitor.



The top looks very simple. It appears the bug consists of just 5 parts. But we know better!

After the bug has been tested it is heatshrunk to protect it from damage. Unfortunately we don't have a photo of the finished product.

The voltage on the active lead of the electret microphone can be anywhere between 70mV and .9v and other than proving a voltage is present, we cannot do any more at the moment.

The voltage on the collector of the audio transistor should be 1v and the base voltage should be about .65v. This will show the transistor is turned on but it can still be damaged due to overheating and not providing any amplification.

One of the ways to prove the microphone is working, and the audio stage is amplifying, is to test the circuit with a CRO.

By whistling into the microphone and checking the audio section, you will be able to see the amplitude increase as you advance across the circuit. Set the CRO to a low mV reading (say 10mV/cm) to detect the output of the microphone and set the horizontal sweep to .2mS/div.

Keep the whistle intensity low (about 1mV p-p) for the final test and compare the amplitude on the base of the audio transistor with that on the collector. You should see a gain of about 50 - 70.

If you don't have a CRO, you can build a small amplifier such as the Simplicity Amplifier (featured in issue 5) and probe the output of the microphone to see if it is operating. Next probe the base of the audio transistor to see if the signal is passing through the 22n and then the collector to see if the transistor has amplified the signal.

CONCLUSION

If you have followed through our discussion and assembled the bug as described, you will have created one of the smallest bugs on the market.

For the final test, lay the bug on the table and stretch the antenna to its full length.

You will need a radio with a signal strength meter (or the Field Strength Meter described in this issue), for this.

Switch the bug ON and measure the output. Cut 2cm from the antenna and measure the output again. Continue until the antenna is about 10cm long and from your readings determine if the antenna length affects the signal strength. You may find the signal strength does not diminish appreciably until the antenna is about 10cm long and you may find certain lengths are more effective than others.

Throw away the pieces of antenna and fit a new 60cm length. Heatshrink the bug and make sure the switch works freely.

This completes our project and I hope yours works as well as ours.

Look for the next chapter in this bug series and be ready for a big surprise.

My Comment

It's sad to hear of the demise, last week, of one of Australia's newer electronics magazines.

Although I am not directly to blame, anyone entering the publishing world is in direct competition with all others on the newsstand.

Whereas we are flourishing, the majority of the other magazines are feeling the pinch of inflation as well as a general decline in sales.

Over the past few years the array of titles has increased and yet magazine sales have decreased. Enormous runs of 300,000 to 1,200,000 for woman's magazines have been cut in half as have the readership of major newspapers.

The reason is manyfold but if we take the case of electronics magazines, the emergence of two new titles, over and above ETI, EA and TE, has spread the readership too thinly.

Gone are the halcyon days when a magazine made a profit for the publishers and even with the paring of staff to three or four dedicated workers, a magazine has only a very slim chance of breaking even.

Forces from all directions have inflated production costs and over the past four years I have repeatedly written about rising costs.

My dire predictions have come true and I still think 3 or 4 magazines is too many for a small market such as Australia.

TE hardly rates a mention on the newsstand and yet our very existence has been been due to me getting my sums right.

Before I elaborate on some of the basic ingredients to success, I want to bring in a parallel case in which a private school went under just a few weeks ago.

What has a school and magazine got in common, you might ask?

Almost everything. They are both non-businesses. Although a magazine charges for advertising, the revenue it receives barely pays the printing bill. This means, in monitory terms, neither have an income.

The only way we have survived is due to the back-up sales of kits and other services such as producing security devices and repairs.

Exactly the same business approach has to be introduced by schools, if they wish to stay solvent in this world of exploding costs. The government has totally let them down and they have to be much more inventive to survive.

I am not suggesting they be turned into a work camp or exploitation centre but a few hours work a week, per student, can produce an enormous return.

Apart from a tuck shop I think a small supermarket would not be beyond reality and even a printing business or hardware outlet would be a success. Of course this would involve students, teachers and parents to make it work and not only would this give the student invaluable interaction between other students, customers and themselves but provide a practical background that is completely missing from present day graduates.

The time has come when businesses of all descriptions have to be more efficient and introduce new ways of creating revenue. With magazines, this is especially true as their whole attention is aimed at providing information for free! Unless there is a reciprocal arrangement with sales or promotions, the cost of advertising is going to force potential advertisers away.

A couple of recent happenings and how you can learn from them

I have seen the frightening result of not having a business head up-front and unless there is a change in tack I can see others disappearing in exactly the same way.

While on the point of making money I would like to relate a recent event involving a firm of investment consultants.

Being a business, we are constantly flooded with promotional blurb on investing for the future, "retiring at an early age," "building up a nest egg," and retiring a "millionaire."

If you have ever been tempted to go in to any of these schemes - be warned. The chances of you seeing anything out of any of them is extremely doubtful. There is not one scheme that offers a guarantee or has the figures to prove you will be better off at the end of the term.

Fair enough, the payout at the end of some of them is higher than the payments you put in but the cost of living in 10 years time will be much higher too.

Here's a simple example. I bought a block of land 2 years ago for $55,000, it's now worth $100,000! Imagine what it will be worth in another 8 years!

So, what do you do with your surplus money?

You use it, buy things, improve your life, build an extra room on the house or if you are really flushed, buy an extra block of land for your country hide-away.

But certainly don't give it to someone else to manage. Each year they bite into it for their management fees and you see very little.

You've already seen tree plantations, nut groves and aloe vera farms go through, pyramid selling schemes get busted, banks fall apart and even 10 year endowment policies that have hidden clauses and catches.

Make it a policy not to let anyone else handle your money and you have a fair chance of retaining its spending power.

The meeting I referred to at the start was a typical "investors" meeting in which a group of "money managers" paint a glowing picture for a particular type of investment.

Using their figures of 13.5% return per annum and an inflation rate of 7.5%, the after tax profit was between 1.5% and 5%!

Who in their right mind agrees that inflation is 7.5%? It's more like 15% - 20%. Just take supermarket prices, house prices or loan repayment figures and you will soon see why to invest for a 10 year fixed term is no better than burying your money in the ground.

If you really want to be smart, start your own business or buy a property with negative gearing. At least you will have something to show for your efforts after 10 years.

The government has closed up so many loop-holes that it is not worth trying to accumulate a nest egg as all capital gains and dividends are taxed.

But if you build up your own business and sell at a profit after 10 years, the money isn't taxed!

This is one of the last areas available to hard working individuals where they can realise a profit on their labours and if you know anything about electronics and sales, you can build up a business that is sure to fire.

Sales and service is the secret and although it will take time to see a return, the fruits will appear in the end.

Obviously you will not be able to compete on all scores with the supermarkets but there is a whole range of consumables that the giants have let fall by the wayside as their accounting says they are uneconomic. We have proven these to be a winner and if you stock a large range of low volume lines you will succeed.

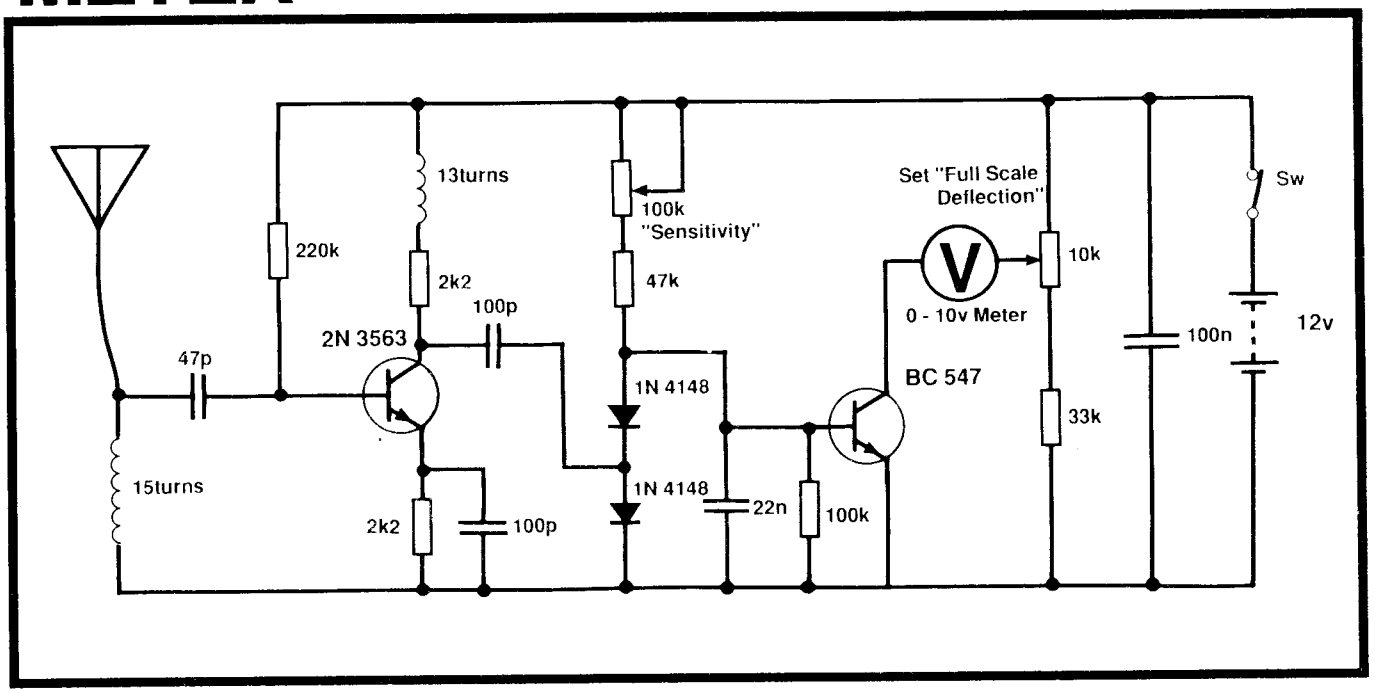
I offer this advice as one who has tried many investments and trusted many people. I've won and I've lost. But the only losses have occurred when I trusted others and tried their investments and schemes.

The only way to succeed is to have absolute faith in yourself.

Build this. . .

FIELD STRENGTH METER

Parts $6.20
PC board: $2.50
Complete: $8.70



FIELD STRENGTH METER CIRCUIT

This Field Strength Meter has been specially designed for our FM bugs. It is capable of detecting very low power transmitters and will assist enormously in peaking the Amoeba and Ultima and checking the output of our other devices.

Up to now, field strength meters have only been able to detect transmitters in the 100 milliwatt or higher, class and for this a simple circuit is sufficient. But when it comes to a low power device such as ours, a simple circuit, with no amplification, is not suitable.

We spent more than 5 days building all the circuits we could find, hoping that one of them would work. Unfortunately none came anywhere near good enough so we had to design our own.

This is the circuit we came up with and it incorporates RF gain, DC gain and another important feature.

The diode pump is turned on via a resistor (the sensitivity control) and this overcomes the .6v threshold of a diode.

You may not think .6v is very much but when you are talking in millivolt terms, it is 600 millivolts.

The signal we are attempting to pick up produces one or two millivolts on the receiving antenna and if you need 600 millivolts to turn a diode ON, the field strength meter becomes very insensitive.

Our design overcomes this problem and produces a reading up to 10cm from a bug.

This means you can now adjust and peak a bug with the antenna fitted and get an accurate reading of the power it is outputting.

Up to now you have had to rely on the "Peaking Circuit" as described in MORE FM BUGS and although it gives a good indication of the RF energy, it does not take into account the loading effect of the antenna.

The antenna loads the output stage and tends to detune it so that a slight re-peaking is necessary if you want to get maximum performance.

The field strength meter will allow you to do this and gain the extra performance that escaped you before.

HOW THE CIRCUIT WORKS

The circuit basically consists of an RF amplifier, a diode pump and a DC amplifier.

The first important feature is the inductor in the antenna circuit. You may think it produces a short-circuit between the antenna and earth but the inductance of the 10 turn coil at 100MHz prevents this and when combined with the 47p coupling capacitor, provides a series resonant circuit that effectively couples the signal from the antenna, to the RF amplifier stage.

The RF amplifier has been designed to only have a gain at about 100MHz to 300MHz and the gain drops off to unity at about 10MHz. This prevents low frequencies from being amplified and upsetting the reading.

The component that determines the cut-off point is the 100p emitter bypass capacitor. It's impedance at 100MHz is 160 ohms and this gives the stage a gain of about 12 at 100MHz. At 10MHz the reactance of

the capacitor is 1600 ohms and the gain of the stage drops to 2.

By increasing the value of the emitter bypass capacitor, the gain of the stage will be increased and may cause the stage to "lock up" due to the front end self oscillating.

The inductor in the collector circuit separates the output signal from the power rail and increases the output amplitude slightly.

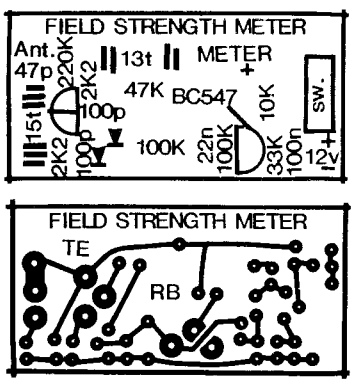
The low value coupling capacitor (100p) between the RF stage and diode pump is sufficient to transfer the energy as, don't forget, we are dealing with very high frequencies.

The two diodes work in a slightly different mode to normal diode pumps. They are forward biased via a resistor from the positive rail and the ratio of the top resistor (100k pot & 47k) to the lower resistor (100k) puts a voltage on the base of the DC amplifier transistor that just turns it on.

The 10k pot connected to one end of the voltmeter sets the full-scale deflection for a 0-10v range on the multimeter.

When a signal is passed into the diode pump, the positive excursions cannot increase the voltage across the lower diode as it is fully turned on, however the negative excursions can reduce the voltage.

The voltage across the top diode does not alter but since its cathode potential is lowered, the anode end of the diode follows and since this is connected to the 22n capacitor, the charge on the capacitor drops.



The circuit is attached to an ordinary multimeter set to 12v scale. The needle "dips" when RF is detected.

This effect is passed directly to the base of the DC amplifier to turn it off and thus the voltmeter needle drops.

Every millivolt developed by the diode pump is amplified by the transistor and this makes the circuit very sensitive.

The 12v supply has been chosen to provide the necessary gain from the RF stage and a lighter battery has been used for this, as it is very small.

The circuit consumes about 3.5mA and with a lighter battery (50mAHr cells) the circuit will operate for more than 12 hours.

A switch is provided to conserve the battery when not required and the board attaches to any multimeter via leads and paper clips that have been bent to suit the banana sockets on the meter.

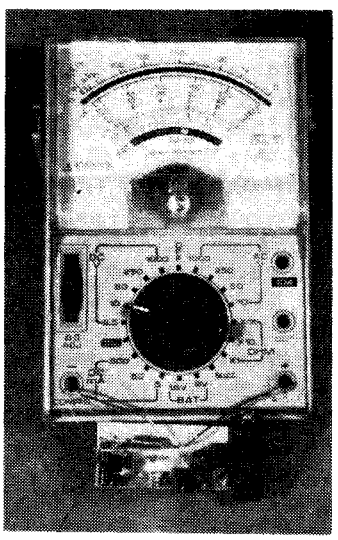
Any old meter will do and it can have a sensitivity from 1k ohms per volt to 50k ohms per volt.

The range we used in our prototype is 10v DC on a 30k ohms per volt meter however 12v, 15v or even 25v scale will be ok and the 25v range simply means the needle will not deflect as much, for the same RF detected.

CONSTRUCTION

All the components, including the 12volt lighter battery and switch, mount on the PC board.

The legend on the board shows where each part is placed and we have found it important to avoid over-heating the diodes and transistors as they lose their peak performance and cause the circuit to become very insensitive.



Follow the overlay on the PC board to see where everything is placed. The coils are pre-wound in the kit and are wound on a 3mm dia Philips screwdriver (if you are making your own) and the wire size is not critical as they simply form a broad-band trap.

The antenna wire is enamelled to prevent it touching the active components of the bug you are testing.

We needn't say any more about construction as you will obviously know how to put the kit together.

PARTS LIST

2 - 2k2
1 - 33k
1 - 47k
1 - 100k
1 - 220k
1 - 47p
2 - 100p
1 - 22n
1 - 100n
1 - 10k mini trim pot
1 - 100k mini trim pot
1 - BC 547 transistor
1 - 2N 3563 RF transistor
2 - 1N 4148 diodes
1 - 13 turn enamelled wire coil
1 - 15 turn enamelled wire coil
1 - 12v lighter battery
1 - 25cm enamelled wire
1 - SPDT slide switch
2 - paper clips
1 - multimeter (0-10v range)
1 - FIELD STRENGTH METER PC board

SETTING UP

Solder the paper clips to the board as shown in the photos and bend them to suit the sockets on the multimeter.

Turn the "sensitivity" control (100k pot) to minimum resistance and switch the circuit ON. Turn the "Set full scale deflection" pot (10k) to give full deflection on the meter.

Now turn the sensitivity pot until the needle justs starts to "dip." At this point the circuit is the most sensitive as the diodes are just turned on and any signal appearing on the mid point of the diode pump will reduce the voltage on the output of

the pair. The Field Strength Meter is now ready for use.

USING THE FIELD STRENGTH METER

This project will help you get the best performance out of any transmitter.

It will gave an accurate readout because it does not connect to the transmitter but registers the strength of the field AT A DISTANCE.

The way it is used is to set up the antenna of the Field Strength Meter in the same plane as the transmitting antenna (to get the best pick-up) and at a distance that just causes the needle on the meter to deflect.

The meter is wired as a "DIP" meter and the needle deflects towards zero as the field strength increases.

Place the bug to be peaked on the test bench, with the antenna outstretched and bring the receiving antenna so that the needle just starts to dip.

Peak the circuit a small amount and take your hands away so that they don't upset the reading, and watch the needle. As the output increases, the needle dips further.

By maintaining the exact same distance between bug and meter, you can compare one bug against another and one design against the next. It's the fastest way of determining the output without doing a "field test."

IF IT DOESN'T WORK

As with all our projects, they work because we have actually built them and checked their performance.

If your doesn't work, the first thing to do is check the value of the components against the overlay on the board.

Two components in the wrong place can make a huge difference and a circuit like this is fairly critical as the biasing must be correct.

Secondly, make sure all the parts are fitted and nothing has been missed out. Also make sure all the connections have been soldered. We still get projects where one or two leads have not been soldered and obviously the project will not work.

Next you can make a few voltage readings. Although they don't tell you too much, it is a fast way of determining if a stage has the correct DC conditions.

The voltages are:

RF Stage:

Collector: 6.1v
Base: 5.8v
Emitter: 5.2v

DC stage:

Collector: .2v
Base: .65v
Emitter: 0v.

If these check out ok, you should make a few further DC tests. If the meter swings full scale at power-up, you should short between base and emitter of the BC 547 to see the needle fall to zero.

This will show the transistor is working ok. If not, the transistor may be shorted.

Next remove the 47k on the diode pump. This will also cause the needle to move down-scale and show the biasing network is working. It is more difficult to test the RF stage and merely probing around the stage with a meter or CRO, will pick up hum and cause the needle to deflect.

Of course we have assumed you have bought a kit and PC board for the project.

The frequency of operation of this circuit makes it important that it is built on the correct PC board. We cannot guarantee "breadboard" jobs or circuits made with your own components as so many variables creep in.

Things like different markings on capacitors, different RF transistors or signal diodes could make the difference between success and failure.

If you know what you are doing, that's fine - you can use your own components. But if you intend to learn from our projects, don't take any chances.

It's cheaper in the long run to get all the projects in kit form and build them exactly as specified.

If you get really stuck, don't hesitate to buy another kit and start again. You can come back to the faulty one later.

This project is so important that we don't want you to miss out.

With a field strength meter you can perform experiments that would take a month to explain in a book.

Here's one:

EXPERIMENTING

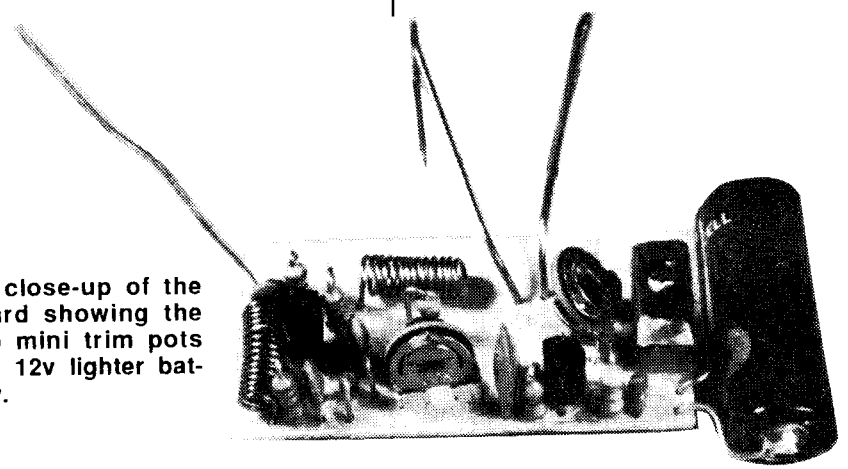
Take the Voyager project and connect 30cm of tinned copper wire to the antenna point on the PC board.

Hold the Field Strength Meter in your hand (keep away from the actual circuit by holding the multimeter) and bring the receiving antenna near the Voyager antenna, without touching it.

As you move up and down the Voyager antenna, watch the needle. It will show that energy is not radiated uniformly from the antenna but has a maximum and minimum value. It is for you to see where these occur. Measure the length of the antenna and plot the results.

Cut 2cm off the antenna and repeat the tests. Fit a 175cm antenna to the bug and repeat the tests. This will give you a good understanding of the phenomenon of electromagnetic radiation.

There are lots of other things you can test with this project including our latest Pen Bug with active antenna and I am sure you will find it essential for RF work.



A close-up of the board showing the two mini trim pots and 12v lighter battery.

MORE FROM TOM

As you may recall, Tom was the designer of the Infinity Bug.

Tom demonstrated his incredible invention to us some 12 months ago and since that time a lot of water has flowed under the bridge.

After the first few bugs were sent out, it was realised that a number of different phone systems existed in Australia. Some are 55v, some are 50v, others are 45v, some reverse polarity just before the ring tone is sent down the line and others are for decadic and DTMF dialing.

When you are dealing with an extremely sophisticated device such as the Infinity Bug, any slight difference in line voltage will upset its operation quite considerably.

We found a difference of up to 3-5v exists on different phone lines and this was more than we planned for. The zeners in the circuit are set to detect a particular voltage and the bug had to be redesigned to account for this.

Once this problem was solved, the next major concern was the fundamental difference between mechanical and electronic phones.

The mechanical phone has an extra line (called the bell line) coming from the back of the phone and terminating at the wall plug. This line is "jumpered" to one of the incoming lines and when the ring voltage is sent down the line, the bell capacitor passes the AC and activates the bell.

Isolating the bell electronically prevents it from ringing and this was very successful on the "no-ring" version.

Everything went smoothly until one customer wanted to silence an electronic phone.

Electronic phones work on a different principle in which the ring voltage is rectified by a bridge and the energy contained in the waveform powers a "ring chip" with a 63mm dia speaker as the output device.

The original "no-ring" principle would not work on the electronic phones and the challenge for the next 3 months was firstly to silence the electronic phone, combine the new circuit with the old so that they did not interfere with one another and then allow them to work on both 45v and 50v lines.

This proved to be an enormous task as one set of conditions interfered with another.

This has all been sorted out now and amazing as it sounds, both electronic and mechanical systems are silenced for the first two rings to allow secret access to the target room.

I suppose we are fairly blaze about the features of this bug as we have seen it gradually emerge over a period of a year or so.

But its capabilities must be pretty impressive as some of the technical staff at a local exchange can't believe it is possible to monitor a room in this way. They bought a unit and I suspect the first thing they will do is take it apart. But they won't get very far as the circuit is not like anything you have seen before and lots of parts are not identified.

We have covered most of the features of the bug in previous articles but we still get a lot of customers who are unsure how the bug operates and where it is placed.

Firstly the bug must be placed in the target room, NOT on the phone you are ringing from. The line in the target room does not have to have a phone installed as the bug does not use the phone at all.

The latest Infinity Bug silences both mechanical and electronic phones.

Secondly the bug is not a transmitting device and thus cannot be picked up by an RF detector.

It simply uses the line to relay information (in the room) to the caller. When the infinity bug is on the line, it is not possible to ring in - you will get an engaged signal. Similarly, if someone is using the phone, the infinity bug cannot be accessed.

If the infinity bug is on the line and someone picks up the phone, the bug will drop off and the user can dial out. The bug requires no batteries as it uses the line as its source of power and will last indefinitely.

The only way of detecting the bug is to fit our Phone Bug Sniffer and this will provide 24 hour detection.

The bug provides valuable monitoring of premises such as shops, factories and houses, and to back-up such devices as auto-dialing alarms that report to monitoring services. By using the Infinity Bug you can dial to the room under surveillance and determine if the suspect is still in the vicinity.

It also has the feature of being able to check the office or home to detect a disturbance (such as the children coming home or waking up) or to find out if machinery is running correctly.

It cannot monitor phone conversations and about as close as you can get is to listen in on one side of a conversation in an office, etc if two incoming lines have been installed.

The need to survey an office is quite important. It is essential to know the attitude of the staff and how they are handling customers.

The cost of any "extra dealings" can be more than you think. If they are running a "business of the side," the cost to you can be enormous.

Most of the cases that have been related to us were accidentally stumbled upon.

Quite often the suspect gets caught out over a very minor slip-up and its only after further investigation that the full extent of the deception is realised.

One incident, that seemed very trivial at the time, involved a hairdressing salon. The manager came to an investigation firm after she realised a few cans of hairspray were missing.

As it stood, the cost of the hairspray hardly warranted investigation, but since it was unaccounted for, the owner was interested to know how it was being used.

An Infinity bug was installed on the phone and during an opportune moment the owner rang a member of staff and made particular mention of the loss of the cans of spray. Without implicating anyone she carefully asked a few questions. At the end of the call she made sure the staff member put the receiver down first.

Accessing the Infinity bug in its second mode of operation, she listened to the staff talking between themselves. It was soon evident that one member had accepted house calls and used the shop products to service the clients.

Not only was the owner being deprived of the spray but also the revenue from the customers treatment. This amounted to more than 20 times the cost of the spray and highlights our point about detecting "the tip of the iceberg."

Space has again beaten me and I will relate some more incidents at another time.

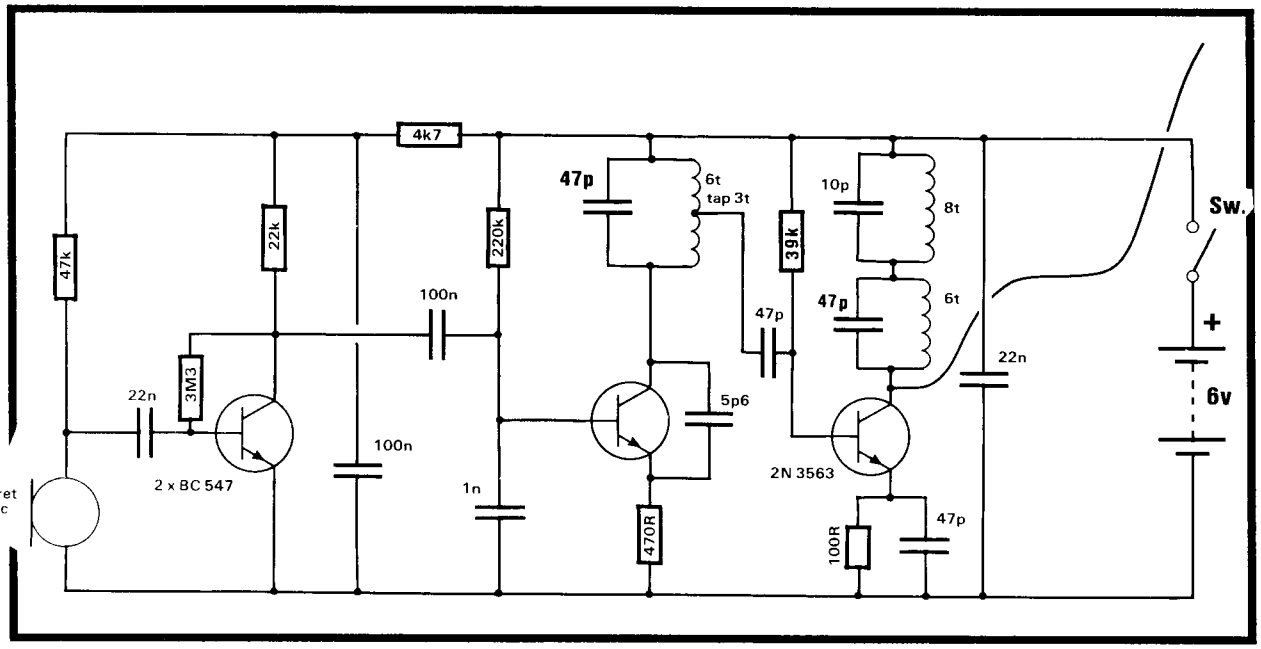
If you would like to know more about the no-ring Infinity bug for electronic phones, contact Talking Electronics on (03) 584 2386. The latest unit will silence both mechanical and electronic phones and costs $330.

Build TE's

ULTIMA

Our 1km transmitter

Parts $10.00
PC board $2.50
Total $12.50
Don't forget the LED Power Meter kit: $1.10



ULTIMA CIRCUIT

Encouraged by the popularity of all our previous bugs, we have designed another FM transmitter, this time with a range of 1km.

The efficiency of this design is slightly higher than the Amoeba as the power consumption is about double and yet the Effective Radiated Power (ERP) is about 4 times.

This is proved by the fact that the range is about twice as far - it requires 4 times the power to double the range.

In this project we will cover some of the design features that make the circuit so efficient. Basically it is the higher voltage.

The way it works is this:

This design has a minimum threshold of about 1v so that a circuit powered by a 1.5v battery has very little potential for producing any output. At 3v it can reach about 400 metres and at 6v it can reach about 1km. You will recall the increased range of the Voyager was purely due to the 9v supply and this time the 6v supply, as well as the tuned output, will assist in providing the output power.

With any transmitting device, the primary requirement is range. To achieve this, an effective antenna system must be used and although a dipole or loaded antenna provide a slight antenna gain, the usual purpose for which this project is intended, makes a special antenna impractical.

The main use for the the Ultima is as an emergency beacon or signaling device and in such a situation, the user may only have the branch of a tree to throw the antenna over.

For this reason, and to keep the transmitter compact, a length of hook-up wire about 1.6metre long is provided.

You could say it's another version of our Hiker's alarm, this time without the beep, and is small enough to be carried by anyone on a hiking expedition or skiing holiday.

If a number of adventurers got together and produced a few units, they could install them on and around the area they use and provide a network of communication links in case of an emergency.

PARTS LIST

1 - 100R (all resistors 1/4 watt)
1 - 470R
1 - 4k7
1 - 22k
1 - 39k
1 - 47k
1 - 220k
1 - 3M3

1 - 5p6
1 - 10p
4 - 47p
1 - 1n
2 - 22n
2 - 100n monoblocks

2 - BC 547 transistors
1 - 2N 3563 RF transistor
1 - 6 turn tinned copper wire coil
1 - 6 turn enameled wire coil
1 - 8 turn enameled wire coil
1 - electret microphone insert
4 - AAA or AA cells
1 - mini slide switch SPDT
1 - length hook-up wire for antenna (1.6m long)

1 - "ULTIMA" PC BOARD

(You can specify AA cells or AAA cells)

It would only take one or two instances where a transmitter of this type proves to be a life saver and its worth will be incalculable.

The advantage of transmitting on the FM band should be obvious as most cars are now fitted with an FM receiver and they can be used to pick up the transmission without the need for any special receiving equipment.

If a frequency were set aside at the lower end of the FM band for such a purpose a safety channel could be set up at all types of outdoor centres where the transmissions would not interfere with any commercial operations as few if any FM stations are in remote areas.

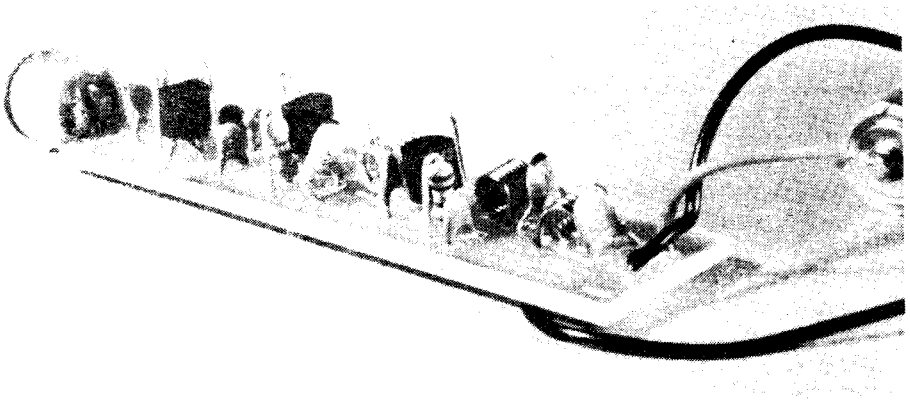
Maybe something like this will be introduced in the near future. It's a "catch 22" situation where you would have to use it illegally, to get it approved nationally.

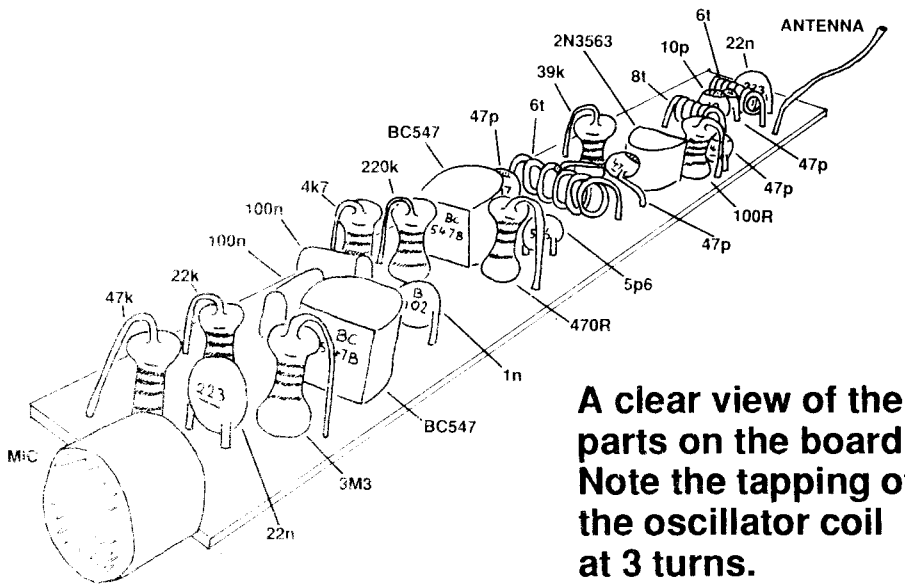
The Ultima project is built on a PC board 1.5cm x 7cm and can be fitted into a variety of cases. The most appropriate will depend on the intended use and if you want the project to be as small as possible, it can be heatshrunk and made virtually watertight.

FM transmission is highly efficient and a few milliwatts can get you a long way. The clarity of FM, its lack of background noise and immunity to electrical interference makes it ideal for faithfully monitoring all types of sounds.

The impressive range of the Ultima makes it ideal as a surveillance device, for monitoring remote sheds and buildings, where the slightest disturbance will be picked up and relayed to the monitoring point.

The Ultima is not intended as a hand-held microphone as firstly the microphone sensitivity is too high and the circuit is not "tight" enough to prevent the effect of stray capacitance of your body causing the frequency to drift. See our hand-held transmitter, the ANT, for this.





A clear view of the parts on the board. Note the tapping of the oscillator coil at 3 turns.

HOW THE CIRCUIT WORKS

The main purpose of a transmitter is to get the greatest distance with the least current consumption.

To this end, the Ultima is the ultimate in design. It contains 3 novel features that have possibly never before been incorporated in the one design before.

The front end is a simple common emitter stage with a gain of about 70-100, and decoupled from the battery via a 4k7 and 100n capacitor. These two components prevent motor-boating (instability) at low frequency.

There's another little known fact to be aware of, when designing the front end of a high gain amplifier such as this.

Since the electret microphone is an active device (it contains a FET), the gain of the FET must not be allowed to be too high, otherwise the front end will break into oscillation (sometimes called front-end squeal).

The gain is kept low by making the load resistor high and that's why we have chosen 47k.

Coupling the audio to the RF oscillator is a 100n capacitor and this value is needed to pass the low audio frequencies.

The first of our "unusual" features is the 220k turn-on resistor on the base of the oscillator transistor.

After a great deal of experimenting we found a very high value base resistor was sufficient to turn the transistor ON and produce a high amplitude waveform.

The oscillator circuit has been designed to oscillate at about 88MHz. The tuning capacitor in the oscillator is 47p and when the frequency is set, it remains set.

The Ultima is not a tunable bug and you should select a clear spot on the dial when setting the bug up, so that you don't interfere with any radio stations.

Apart from being illegal to transmit over a commercial station, you would have almost no chance of achieving any range if you were to do so.

The output of the oscillator is taken from the third turn of the oscil-

lator coil and this is common practice in transmitter circuits - it has been done with the Amoeba and has proven to be very successful.

Quite often the tapping of a coil is very critical and half a turn either side of the optimum value will reduce the performance considerably.

The idea of tapping a coil is to produce an auto transformer. This has nothing to do with cars (auto's) but means a two-winding transformer is produced by using only a single winding.

We all know what a transformer does and one of its features is to change a high voltage, low current packet of energy into a low voltage, high current package.

In a limited way, that's what the tapping on the oscillator coil does. It produces a very efficient matching between the oscillator section and the output stage.

The aim of the tapping is to pick off as much signal as possible without overloading the oscillator.

In technical terms we need a considerable amount of current to drive the output stage as its gain is quite low (possibly about 5-20), depending on the quality of the transistor and the frequency of operation.

At 100MHz, the reactance of the 47pF in the base of the output transistor will be only about 40 ohms and that's why a small value such as this can be used.

The output stage has a number of features worth mentioning.

Firstly the emitter capacitor and resistor network may appear to be unnecessary as the stage is not a full bridge design. These components reduce the peak current and increase the input impedance of the output stage as seen by the oscillator stage. This improves and guarantees "start-up" of the circuit.

To get the greatest range out of the Ultima, the output stage must be peaked and this is an essential part of the tuning and aligning. The tuned circuit in the output stage consists of a 6 turn coil and 47pF capacitor. The 8 turn coil is effectively an RFC (Radio Frequency Choke) to improve the matching of the output circuit to the antenna. The 10p capacitor across the RFC is designed to reduce harmonics and prevent interference on TV sets in the vicinity.

As output power is increased (such as from the Gnat design, to this), the effect of harmonics becomes a real problem.

Shielding the project will have little effect as they are already appearing on the antenna and it's too late to suppress them once they get this far.

As we have said, one of the important stages in the construction is to peak the output. To do this, a simple POWER METER is required and its construction is also covered. The circuit attaches to a standard multimeter and uses the meter to give an indication of the signal strength. It also has a Light Emitting Diode that illuminates to give an indication of the relative power being emitted.

The illumination of the LED will give you a valuable indication when peaking the circuit and will show how critical the values are at high frequency.

An on/off switch allows the project to be turned off when not required and the current consumption of our prototype was measured at 8mA, allowing a set of AA cells to last for about 150 hours.

The 2N 3563 transistor in the output has been chosen as it gives the best performance at the least cost.

Surprisingly, a BC 547 will operate quite satisfactorily as an oscillator at 100MHz but provides very little gain at this frequency.

It only requires a gain greater than unity to function as an oscillator but in the output, a 2N 3563 provides a gain of between 5-20 and delivers the output we need.

No matter what other tricks you add to the output stage, you will not achieve better performance - for the same current.

The suggested maximum current for a 2N 3563 is 10-12-15mA (depending on the specification sheet you use), and only by decreasing the value of the bias resistor, does the output rise by a noticeable amount.

As you experiment with the circuit and peak it, you will see the changes in output power on the meter and/or the LED. But if the range is increased at the expense of more current, you haven't improved the efficiency.

Our prototype produced 2v across the LED/resistor combination and the chip inside the LED could be seen to glow quite noticeably.

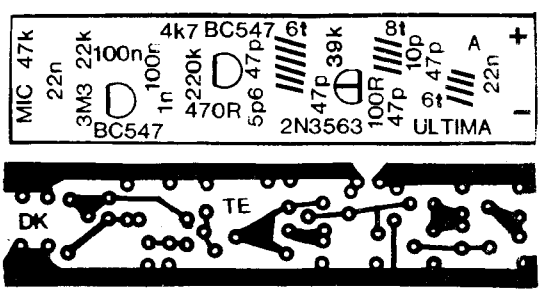
Not a great deal of weight can be put on this as a lot of RF energy is floating around the meter and will get into the movement to create a false reading.

But if you can see the LED glowing you know that energy MUST be present and that's why we have called it a LED POWER METER.

ASSEMBLY

A complete kit of components, including pre-wound coils and roll-tinned PC board is available from us and we hope you will buy more than one kit! Many readers buy two or more for their friends and some keep coming back and back! We have sold over 10,000 ANT bug kits already!

The artwork for the PC board is also given so that you can make your own, if you are set up to do so. But the economics of making your own board is dubious.



PC Artwork for the Ultima. The switch is soldered directly to the AAA cells with small lengths of tinned copper wire and the other ends of the cells are connected to the board via short lengths of hook-up wire.

By the time you buy the blank board, cover it with ultra-violet sensitive material and spend an hour or so etching and drilling, you could have bought a professionally made board from us for less.

Before arriving at the final design, we built at least 12 experimental versions, all with parts hanging off the board, in a birds-nest array.

Without exaggeration, it has taken hundreds of hours of experimenting and at least 100 trips "around the block" to see how effective each modification has been.

Sometimes an improvement via the power meter did not co-relate to an improvement in range. You must always make a "field test" - it's the only proof.

Although the circuit is not critical as such, a lot of work has gone into the selection of each component and the layout of the board.

If you want your model to perform as good as ours, it is important to use the exact same components and the same layout. That's why I suggest you buy a kit.

If you are a seasoned hobbyist, and know what you are doing, you will know the type of components to use. But if you are unsure or missing one or two of the critical parts, don't take the chance, buy a kit.

Kits have proven the most popular way of making a project.

The ratio of "kits" to junk-box assembly is greater than 50:1, in our experience of over 100,000 kits. Kits are generally no more expensive than buying the parts individually and quite often some of the special components are not readily available, like the wire for the coils, the RF transistor and high quality electret microphones.

I am not going to go through the finer points of placing the parts on the board as we expect you will have made some of our other designs already.

The coil winding details are below for those who wish to wind their own. You can use slightly different gauge wire but the coil diameter and spacing is critical.

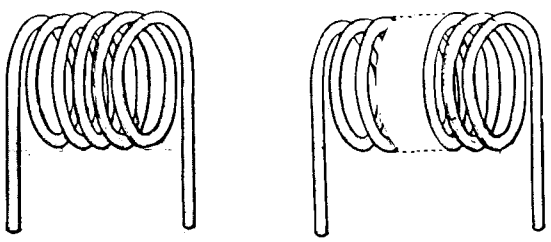
All the parts for the Ultima fit onto the board almost exactly as they appear in the circuit diagram. This makes the circuit very easy to follow and is one of the factors to good layout.

Two of the coils are enamel coated and the enamel must be scraped off or burnt off before fitting them to the board. It is not satisfactory to expect the enameling to burn off at the time when the coil is being soldered in place.

All the components should be pressed firmly up to the board before soldering. This also applies to the transistors. They should be pushed down to the same height as the resistors as can be seen in the photograph.

There are three points that may be new to many constructors. The first is the soldering of the 47pF to the top of the 3rd turn of the oscillator coil (the tinned copper wire coil).

The turns are counted from the "earthy" end and earthy end means the end that is not alive or oscillating.



COIL WINDING DETAILS:

1 - 6 turn tinned copper coil (.6mm wire) wound on a 3mm diam screwdriver.
1 - 6 turn enameled wire coil (.5mm wire) wound on a 3mm diam screwdriver.
1 - 8 turn enameled wire coil (.5mm wire) wound on a 3mm diam screwdriver.

The turns are counted at the top of each loop. Six loops at the top indicates a six turn coil etc.

The end connected to the positive rail is not "alive" and although it not earth as far as DC is concerned, the rail is "dead" as far as the signal is concerned - the active end is the collector end.

When making the connection, make sure the solder does not bridge across two turns as this will create a shorted turn and the transmitter will either not work at all or operate on a much higher frequency - we have had both occur, although I would prefer to state that the shorted turn will prevent the circuit from operating at all.

You should also take care that bending the leads of the 47pF does not damage the capacitor or create an open circuit. They are fairly delicate.

Finally, removing the enamel of the coils, must be mentioned.

The acid fumes that are produced when burning the enamel are so strong that they will attack the plating on the tip of your soldering iron.

I have already gone through a number of tips and put it down to this procedure as the pitting has developed after removing the enamel from a number of coils. Normally a tip will last for months but after a few "removals," the tip succumbs to a "crater." Soon after, the tip falls off.

You should remove the enamel with a blade, sandpaper or file and the ends must be cleaned and tinned before fitting the coil.

All the rest of the construction is straight-forward. The PC board contains a legend and the accompanying photos will show where everything goes.

The next stage is tuning and peaking but before this can be carried out, you will need to make up the LED POWER METER.

LED POWER METER

To get the best performance out of this transmitter, an RF power meter is used to maximize the output.

Since the output is very low, a conventional RF power meter cannot be used. We need an RF milliwatt meter.

The circuit described in this section is very simple and uses a standard multimeter to show the reading.

Across the input is a LED and resistor and the degree of brightness of the LED, together with the voltage reading on the meter, gives an indication of the energy level.

A digital multimeter may be used but the presence of RF may produce a false reading.

Likewise, the radiated energy may upset some analogue meters and you may get full scale deflection on the 15v range as well as the 250v range! But the LED won't lie. It will accurately indicate the RF and you can see the change in brightness as you adjust the coils in the output stage.

LED POWER METER

PARTS LIST:

1 - 470R
1 - 100p ceramic
1 - 100n greencap

2 - 1N 4148 signal diodes
1 - 5mm red LED
1 - 5cm hook-up wire
2 - paper clips

NO PC board required

Build the circuit for the LED Power Meter exactly as shown in the photo and make sure the input lead is exactly 5cm long. If you keep to the same layout as shown, your readings will closely coincide with ours.

When dealing with RF, lead length is very important and if the input lead is longer, the meter will produce a lower reading.

The type of multimeter will also affect the reading and this is why we cannot give a quantitative value for the output.

We don't have any means of providing a "standard" as we don't have any bench-mark or reference point.

As soon as you build the power meter you will be able to test the transmitter.

Connect the input lead to the antenna point (don't fit the antenna lead yet) and switch on. Switch the multimeter to the 2v (or 2.5v or 5v) range.

Keep the transmitter away from the meter to prevent the movement being influenced by the RF and you should get a reading of about 2v.

The LED will glow quite noticeably and you can see the output on the LED before the circuit is peaked.

Next you have to tune the transmitter to a clear spot on the dial. For this part of the operation you will need a transistor radio, or more preferably, a radio with a tuning indicator.

Keep the radio at least 2-3 metres away and tune to a clear spot.

The lead of the power meter is used to radiate the signal and you will get a range of 10 metres or so.

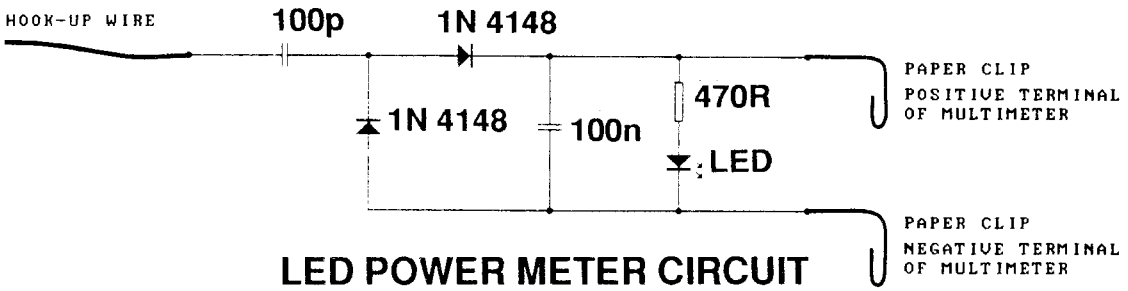
Turn the transmitter ON and adjust the turns of the tinned copper wire coil to get a feedback whistle from the radio.

There may be a number of spots where a signal is detected and it is important to pick the fundamental.

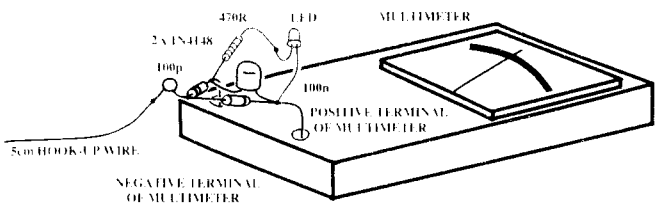
The weaker side-tones have no range and this is where a tuning indicator comes in. It will quickly indicate the fundamental frequency.

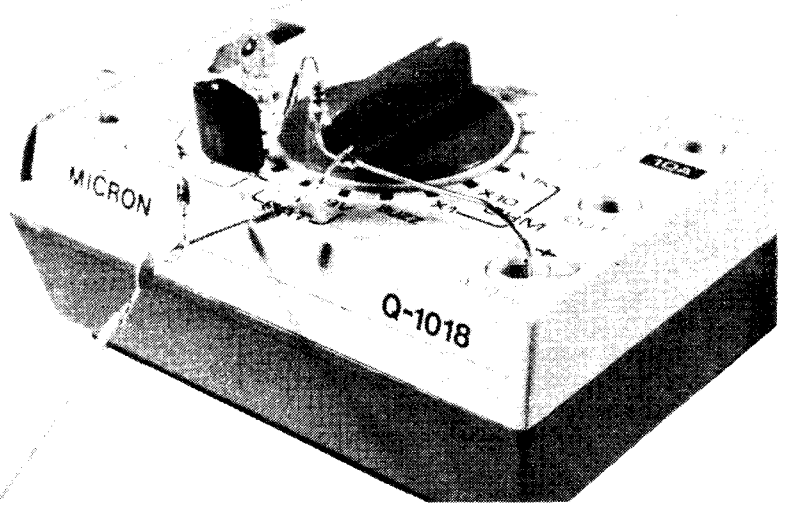
Move the radio away to confirm that the fundamental is being detected.

Once the frequency of transmission has been set, the peaking of the tuned circuit (in the output stage) must be undertaken. This is done by squashing or stretching the turns of the 6 turn coil and as you do this, you



LED POWER METER CIRCUIT





LED POWER METER

These diagrams give a clear view of the LED POWER METER connected to an ordinary multimeter. The parts are soldered to two paper clips and connected to the input terminals of the meter. Set the meter to low DC volts scale. Make sure the input lead is 5cm long to get the same readings as discussed in the article.

will be able to see the effect on the LED POWER METER.

In this way the output stage can be optimized and you can be sure the maximum output has been gained.

MODS

If you want to detune the transmitter to below 88MHz or run it at the top end of the band, you will have to change the oscillator section as well as the output section as they both determine the frequency.

To detune the transmitter to say 85-87MHz, you will need to add one turn to both the oscillator coil and the tank coil, making them 7 turns.

To operate at 108MHz, you will need to change both the 47p's in the oscillator stage and tank circuit to 39p and follow the peaking procedure described above.

IF IT DOESN'T WORK

Before you get involved in any technical problems, have someone check the construction for dry joints, parts placement, shorts, and the like. Nine times out of ten it's something simple.

Next check the current. It should be 8-10mA and any value outside this will indicate a fault is present. Also check the voltage across the power rails and the voltage across the front end (about 5v).

Next you must determine if the fault is in the audio section or the RF section.

If the carrier is being produced you will get a blank spot on the dial and the power LED will light up.

In this case the fault lies in the front end and can be due to the microphone being around the wrong way, the audio transistor being faulty, the 100n capacitor not passing the signal or one of a number of faults.

Firstly check the voltage across the electret microphone. If it is between .1v and 1v, the mic is drawing current and if you want to see the output signal, you will need a CRO or mini amplifier.

A voltage of 2-3v on the collector of the audio transistor will indicate it is biased correctly and any value outside this may mean the transistor is faulty or has a gain above or below that expected.

In a self-biasing stage such as this, the gain of the transistor sets the collector voltage and maximum amplification is achieved when the collector is sitting at mid rail.

Two other components affecting the audio are the 22n and 100n capacitors.

They may be damaged due to soldering and the only way to check them is by bridging another capacitor across each or using a mini amplifier to detect the audio.

If you have access to a CRO, you can observe the signal at each point in the circuit and almost no fault will escape you. (Only the audio section).

Replacing all the components in the front end is a last resort but may be necessary if simple tests do not reveal the fault.

On the other hand, if no carrier is produced, the oscillator or output stage will be at fault.

Firstly check the oscillator stage by removing the 47p capacitor from the oscillator coil and connecting the input lead of the LED POWER METER to the collector of the BC 547.

The meter should deflect slightly but the LED will not come on as it requires at least 1.7v to be present before the LED will start to illuminate.

The LED and resistor do not have to be removed as they do not impose any load on the circuit until the voltage rises to above 1.7v.

If the meter does not deflect, the fault will lie in the oscillator stage. The first component to change is the transistor, then the 5p6 feedback capacitor.

Make sure the 220k turn-on resistor is providing a voltage to the base of the oscillator transistor. It will be difficult to measure this voltage accurately as the stage is producing RF and will upset the meter reading.

Make sure the 470R has a voltage across it and this will indicate the transistor is turned-on.

If the 47p capacitor has shorted, or if two turns of the coil are touching, the circuit will not oscillate. If these tests fail to locate the fault, you should assemble another kit and come back to this one later.

Re-connect the 47p and take the LED Power Meter to the antenna connection.

NO deflection of the LED POWER METER can only mean one thing. The output stage is not operating.

Firstly test the output transistor and make sure the voltages are correct. Don't forget the 47p that taps onto the 3rd turn of the oscillator coil. Replace it if you think it has been damaged during soldering.

The enamel on the coils must be removed before soldering as it does not conduct electricity at all.

Make sure the 39k provides a turn-on voltage and you can try shorting across the 100R if you think this resistor is open.

A low RF output can be due to an open 22n capacitor across the battery, the coils in the collector being spread too far apart or a faulty RF transistor.

The only other possible explanation is damage to some of the components during soldering.

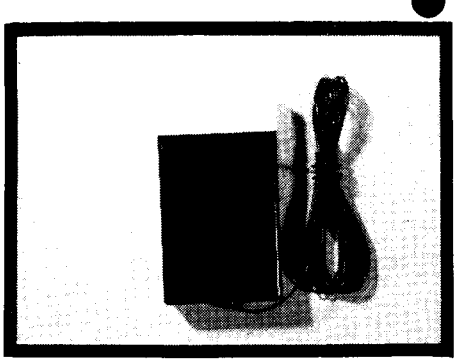
For the cost of another kit, the quickest and easiest way is to start again. You will take more care with the next construction and hopefully things will work out successfully.

MOUNTING IN A BOX

The project can be mounted in a jiffy box that is large enough to take the PC board and a battery holder. This will give it protection from the weather etc if used in an outdoor situation.

If you want the project to be as small as possible, the PC board can be heatshrunk but you must be careful that the heatshrinking does not move the coils and change their frequency. Do not use a voltage higher than 6v as the circuit is not designed for it and harmonics will be produced that will interfere with TV reception.

I hope you find this project as interesting as we did. The range is most impressive and it is incredible that such a low output will reach 1km.



OMNI SOFT

2 Central Avenue, Moorabbin, 3189. Victoria. Ph: (03) 532 0236

UP-DATE

One of the big surprises from issue 15 was the popularity of public domain and shareware software. Even though we advertised only a hundred disks, we received many orders and inquiries. Because of the interest shown we have decided to push on and expand our library and produce several publications.

In the following pages, we have listed the most popular public domain disks from the PC-SIG library. While this is just a small sample, it shows the tremendous range of software available.

A more comprehensive catalog is available for $7 posted. This is a directory of over a thousand disks from the well-known PC-SIG library.

To avoid confusion OMNI SOFT have decided to adopt the same numbering systems as used by the various libraries. So if you have a catalog of PC- SIG or PC-BLUE you can use it to order disks from us.

Shortly we will add the PC-SAIL and PC-GOLD collection to our library and we believe this will make us the cheapest and best stocked of all public domain suppliers in Australia.

OMNI SOFT will also have its own unique numbering system as we plan to supply many of the hundreds of public domain programs not currently supplied in Australia. Australian Programs will also be covered under this numbering system.

Apart from aiming to be the best public domain supplier, OMNI SOFT is producing a year book to appeal to a broad range of interests. One thing the event of public domain has done is to bring to common ground a large section of the computer industry. The year book will reflect this by containing articles on public domain software, hardware tips, peripheral projects, program listings, tutorials for the beginner etc.

The information in a year book quickly falls behind and so in addition to the year book, a bi-monthly newsletter will be sent to those who take advantage of our subscription.

Our newsletter will do more than just up-date the directories. It will contain articles in a similar vein to the year book but more importantly provide a forum where you can express your views and ideas. One of OMNI SOFT's contributing editors is Les Brown from Moorabbin Industrial Electronics. Les will provide answers to your questions on hardware through his column. If you have any queries on disk drives, monitors, mother boards etc. Write to Les C/- OMNI SOFT at the Talking Electronics shop. OMNI SOFT also has contacts with Micro Science, suppliers of computer hardware. They will keep us a breast of the rapidly changing prices and technology.

Bulletin board users haven't been over-looked as we hope to work with some well known Bulletin Board operators or start our own—stay tuned.

The year book and newsletters are available by subscription. The subscription fee is just $20 and includes the first edition Catalog. This is good value no matter what language you program in! The catalog will be sent as soon as we receive your subscription and the year book will follow when completed while newsletters will arrive each two months. If you have any ideas, reviews or questions, send them in so that we can reply through our next publication. If you send us a review that OMNI SOFT can use in a newsletter or even in the year book, you will be credited with a free disk from our library. Some advertising space is available in the year book including free space for classifieds. Ring the shop and talk to Ross if you are interested.

Don't confuse the subscription fee with a membership fee. Even if you don't subscribe, you can still purchase disks from us for just $5 ($6 posted). The software will be sent on a top-quality disk and comes with a life-time guarantee. Look through the next few pages to see some of the disks available. You can use the order form at the end of the listing to purchase those disks you want through the mail.

Hope to be hearing from you soon !

S-105 PC PROFESSOR BASIC TUTORIAL

PC-PROFESSOR is a well liked tutorial for teaching the BASIC programming language. Start by running the BASIC program "intro".

S-120 PC-CHESS

This popular program allows you to play against the computer with several levels of difficulty or a human opponent. Also you can set the computer to play against itself. Recommended as a good learning aid.

S-254 PC-DOS HELP

This programs give you an on-line help capability for DOS commands. Just type "HELP" if you don't remember the command for doing something. This is a user-Supported program.

S-287 FILE EXPRESS (1 OF 2)

FILE EXPRESS is an information management program. It allows easy manipulation of small and medium sized databases using menu driven commands. File Express allows you to create and maintain files of facts figures names mailing lists patient records or what have you. See additional programs on disk S-288. This is a highly recommended program that anyone who needs a database program must have!

S-288 FILE EXPRESS (2 OF 2)

This is the second disk of File Express. See S-287 for details.

S-293 ARCADE GAMES

Really fine collection of colorful arcade games. If you can't find a game to suit you here perhaps you're not a games player. This collection of games for the color tube will catch and hold your attention for hours. They work well on the PC-jr also.

S-294 EDIT-VER 1.11

EDIT is a general purpose text editor and word processing program. It supports a wide array of editing operations including powerful commands that are often not available even in very expensive word processors. It supports "word wrapping" and fully automatic paragraph reformatting. Under versions 2.0 or later of DOS edit even allows you to execute DOS commands or start another program without leaving edit. Files are limited to about 50,000 characters (25 single spaced pages).

S-320 TOUCH-TYPE

The two programs on this disk are: FASTYPE a tutorial system to teach the IBM PC keyboard and: TYPERITE a program that turns your PC and its printer into an electric typewriter. I found the typing tutor to be very useful.

S-326 PRINTER UTILITIES

Assorted printer routines. Everything from sideways to WordStar strip routines to TSR printer setup utilities to be found here.

S-344 PC-KEY-DRAW (1 OF 2)

A very powerful combination of programs providing keyboard to screen drawing graphics printing and slide show capability. The drawing program allows creation and editing of graphics screens. Built-in technical functions allow use as a cad system. (User supported requested fee $70). Demonstration files are on S-345.

S-345 PC-KEY-DRAW (2 OF 2)

Demonstration files to be used with PC-KEY-DRAW. To run slide show demo (DEMO.SHW) disk must be in drive B:. All .PIC files can be retrieved using f7. All .SCN files are retrieved using f10. Main program is on S-344

S-405 PC-DESKMATES UTILITIES

PC-DESKMATE is an accessory program that can be called from any program or DOS. It includes the following utilities: alarm clock, calculator, calendar selected DOS commands, notepad, phone dialer, printer control and typewriter. It is menu driven, has help facilities and can be used either as a stand alone program or in memory resident mode (with the ability to change the start key). This is a super alternative to sidekick and has more features and great documentation.

S-414 COPY PROTECTION and UNPROTECT UTILITIES

Here's a gold mine of information about running copy-protected and 'key-disk' programs from your hard disk or to make back-up of the originals. Generally these are step-by-step detailed instructions to walk through a debug session that will allow easier use of over 30 of the most popular copy-protected software products. Also included are programs to make your disk files 'read-only' and back to 'read-write' (including BASIC programs saved with protection).

S-439 COMMUNICATIONS PROGRAMS

MODEM86 is a communications program for Intel 8086/88 based computers. It runs under both CP/M-86 and MS(PC)-DOS. It provides such features as file copying using Xmodem protocol terminal emulation file transfer with all hosts x-on/x-off flow control batch mode optional on-line help and menus file transfer and conversion utilities and auto-dialing. "IT" is an easy to use modem communications program without a complicated setup. IT has a clean uncluttered look emulates a VT-52 terminal. IT supports XMODEM protocol yet allows autodial with Hayes compatible modems. IT stands for Intelligent Terminal.

S-452 THE AMULET OF YENDOR ADVENTURE GAME

This dungeons & dragons type adventure comes from Amsterdam. Originally running on a Unix machine it was converted to MS-DOS by Keller. This adventure is played on 20 levels against many monsters and very powerful magic. You can be an explorer, warrior, magician, tourist, knight or a caveman with all their associated powers. Requirements: 256k memory minimum 2 disk drives and DOS 2.X Or higher.

S-456 ASSORTED GAMES

Here is another fine collection of games that will keep you busy for years to come. FIRE is a good strategy game in which you must use fire breaks and water drops to keep your section of the forest from burning away. AIRTRAX is a very good game in which you as an air traffic controller try to land a number of planes. PTROOPER is a good arcade shoot-em-up that will keep you guessing. For you gamblers out there we've got a version of the old favorite POKER

S-457 BEST ARCADE GAMES

Assorted Basic and compiled games. Most need CGA to run.

Games include classics like DONKEY KONG and SCRAMBLE plus various others. If you have a CGA card and enjoy stimulating games, add this disk to your colection.

S-476 PATRICK'S BEST GAMES

These games were gathered from previous disks to provide a good representation of high quality games for the new user. In answer to complaints that most of the best games require

color screens only 3-DEMON and SPACEVAD out of the seven included games need a color graphics card. 3-DEMON runs on HGCIBM colour emulator 100%

S-480 PC-OUTLINE V1.04

PC-OUTLINE is a program comparable to thinktank. It gives you the opportunity to outline and organize any items by helping you arrange and re-arrange them using different categories of classifications. Aclaimed for its ease-of-use.

S-481 STILL RIVER SHELL

The STILL RIVER SHELL Shell provides a better working environment than DOS. It saves time by allowing the use of one key commands and at the same time lets the user do anything that DOS would normally do. A good program for those who insist on a user freindly enviroment.

S-514 CASINO GAMES

This games disk has 8 programs which will give you hours of fun and relaxation. ROULETTE and KENO might be used to develop your own system of beating the casinos. I found the 3D TIC-TAC-TOE and the OTHELLO games to be just great fun for they match your wits against the computer. The PC-OTHELLO game is meant to be played by two computer users over the telephone. If you are a serious internals person with experience in assembly you may find COREWARS to be both fun and a learning experience. The BIORHYTHMS charting program is very good. All in all a nice collection of computer games.

S-521 FREEFILE VER 1.0

FREEFILE is a relational data base system that allows a user with little or no programming experience to determine how files are to be created, enter information and print reports. It is particularly useful for those interested in maintaining a collection of information with the ability to set up calculated fields and import or export data to and from other packages. Freefile has online help and two tutorials with explanations. It allows ten indexes per database, 2 billion records at 1000 characters per record and 100 fields per record.

S-523 SIDE WRITER

SIDEWRITER is a program that allows printers to output sideways on paper. This allows the printing of reports and other materials that do not fit in the number of columns allowed across the page because it prints down the length of the sheet instead of across the width. It works much like the commercial program "SIDEWAYS". The program is written in Pascal and the source code is provided with the package. Easy to learn and use.

S-528 NEW YORK WORD VER 1.2 (DISK 1 OF 2)

NEW YORK WORD is a very powerful word processor that allows split screen editing, movement of text between windows, the creation of (macros) that perform functions with just a few keystrokes, footnotes, automatic table-of-contents index generator, automatic hyphenation, mail merge and a programming language. This is a user supported package more powerful than most retail word processors!! This disk contains a complete set of documentation for the program which is located on S-529.

S-529 NEW YORK WORD VER 1.2 (DISK 2 OF 2)

This is New York Word's second disk. See S-528 for documentation.

S-557 PINBALL RALLY

Here is a disk for the pinball addict. It has three games which have been created using the program "pinball construction set" by Bill Budge. The games vary in the level of difficulty but they are all interesting. The three games include pinball which is the standard pinball game, RAIN is more complicated as it uses 5 pinballs at the same time and TWILZON2 is perhaps the most difficult something for the Rod Serling fans. Requires a CGA card.

S-577 C TUTOR (DISK 1 OF 2)

This is the first disk of the C tutor system. This is a comprehensive introductory tutorial to programming in the C language. This disk contains the textual tutorial material in a series of .TXT files.

S-578 C TUTOR (DISK 2 OF 2)

This is the second disk of the C tutor system. It contains the example C programs as discussed in the text portion of the tutorial. See S-577 for details.

S-598 MASTER KEY V1.6C

MASTER KEY is an incredibly powerful and easy to use disk and file manipulation utility comparable with if not better than commercial programs like the Norton utilities. With this program the user can edit any part of any disk or file using a handy windowed HEX and ASCII dump of the file on the screen. Editing can be from the ASCII text or from the hex dump. Menus and excellent organization allow the user to quickly learn the package. Many other utilities are also included such as a duplicate file search file renaming and erasing abilities DOS directly updating as well as file unerasing. The program comes with 30+ pages of well written documentation.

S-608 AUTOMENU VER 3.01

Automenu provides a menu system for your batch files, programs and DOS commands. It will work with or without a mouse and allows you to define your own menus. A very powerful and popular program!

S-610 PACKDISK VER 1.3

This disk has a useful array of disk utilities. PACKDISK being the most useful file on the disk. It eliminates file fragmentation which will in turn optimize the space on your disk. Not only will this save disk space, but speed up disk accessing times.

S-631 HDM-II

HARD DISK MENU system is a DOS shell which allows the user to create a 10 page 100 entry) menu of macro's ("batch"-like command sequences) for loading and running your favorite software or performing common DOS functions. The program is easy to set up and includes extensive help screens within the program. HDM-II allows the use of user defined variables and parameters to create complex command sequences. Passwords can be set up to prevent unauthorized access to any (or all) menu selections or functions.

S-646 AMY'S FIRST PRIMER

AMY's FIRST PRIMER is a collection of simple games for young children that help them with skills like counting letter recognition simple problem solving pattern recognition and keyboard use.

S-683 B'NWARE ADVENTURES

This diskette contains two of J. Button's adventures in his adventure series. In the first game, CASTAWAY, button shipwrecks you on a small island without supplies, it's your problem to get home. This adventure is built for those novice adventure players says button. The next adventure is more educational as you are to travel throughout South America collecting information for the United States. Players learn basic geography playing this adventure. Each adventure is well documented during program execution.

S-694 SLEUTH VER 4

This interesting crime solving game will work on a black and white monitor and only needs the keyboard and disk for input. The objective is to determine among six suspects which one has committed a murder, discover his or her murder weapon, find the location that the murder took place and accuse the murderer in everyone's presence. Unfortunately the guilty one quickly tires of the investigation and plots to end the game for you prematurely.

S-705 KIDGAMES

This disk contains a collection of games specifically geared toward the ages of 2-10 years of age. Your children will not only have fun with these games but will also learn from them.

S-710 INSTACALC VER 2.00

INSTACALC is a full-featured spreadsheet program with an interesting twist: it's memory resident. This means that when first-run (when you type insta and press return) nothing appears to happen. INSTACALC has simply been loaded into memory and is now waiting for you to "call it up" by pressing alt-I. INSTACALC will wait patiently while you type a letter with your word processor update your database or whatever then when you press the magic alt-I there it is ready to serve you. Aside from that it has some more useful reasons for existing. For example suppose you wanted to add a table of figures from your spreadsheet into a letter you were typing on your word processor. INSTACALC allows you to do this automatically in one step.

S-718 LQ PRINTER UTILITY VER 2.26

LQ is an impressive printer utility that lets you use your inexpensive dot matrix printer to print a variety of fonts on your Epson (or compatible) in near-letter-quality. LQ may be used as a memory-resident program working with your word-processor or it may be used alone to process individual files. LQ comes with a large assortment of predefined fonts including courier, greek, helvetica, roman and many others. A character editor is provided to allow you to modify or create your own fonts. bigprint allows you to print large letter banners on your printer. LETHEAD is a graphics editor which works in conjunction with LQ to produce high-resolution letterheads consisting of 1" x 1" pictures and up to four lines of accompanying text.

S-727 POWERMENU VER 2.00SW

POWERMENU is an operating environment for your IBM-PC or compatible which acts as a "super highway" to provide easy access to any application on your PC. POWERMENU is particularly suited for end-users who would rather not worry about sub-directories, command line parameters and command names. For instance you can set up your POWERMENU to run a word processor when the "W" key is hit. Users exit from word processing are back in the main POWERMENU and need never interact with the disk operating system (DOS)! user-friendly powermenu has a menu structure like sidekick and it includes context-sensitive on-line help at the touch of a key. Also featured are: user-definable colors, password protection, submenus, a screen save feature, instant DOS, and dbase iii compatibility.

S-734 EXTENDED DOS

EXTENDED DOS is the latest offering from Buttonware. It provides some very useful extensions of the most commonly used DOS commands as well as adding a couple of features which DOS doesn't have. Extended DOS can be as simple or as complex as you need. Experienced users will probably want to type the individual commands while the novice user can simply type xd and be presented with a menu of all the commands. In the menu mode the program will walk you through each step of the command you choose. Extended DOS is well suited to all skill levels from novice to expert. The documentation supplied with extended DOS is excellent providing easy to understand instructions for getting started. The program also contains on line help files when using the menu mode. ED will run on any IBM-PC or compatible with 64k of memory and at least one disk drive.

S-764 GALAXY VER 2.2C

GALAXY is a fast RAM-based word processor that offers a wealth of features designed to make the program powerful yet extremely easy to learn and use. Galaxy offers users a choice of using menus or quick keyboard commands for all of the major program functions. With GALAXY you're never stuck with a cumbersome menu system for commands you already know and you're never stuck with a confusing command-based system for commands you use less often. GALAXY has a very short learning curve. GALAXY's logical easy-to-use easy-to-learn commands are the result of considerable research into how people really use word processors. If you have experience using any word-processing program you'll be up and running with galaxy in no time. If you're new to computer word-processing or to MS-DOS computers you'll be pleasantly surprised at how quickly you'll be able to learn all the features of GALAXY.

S-800 BAKERS DOZEN BY BUTTONWARE

BAKER'S DOZEN features more than thirteen handy utility programs in one package. You may either run the programs alone or from the menu. BAKERS DOZEN includes a powerful disk program to recover deleted files. Calendar has the option to make it memory resident. Mini-spreadsheet is small but powerful. It will support formulas trig and business functions as well as hexadecimal/decimal conversion. Locate finds files on any disk and will also find strings of text within files. Baker's Dozen also has a sideways printer utility as well as many more. This disk is a must for the novice or pro computer user. Yet another brilliant program from Jim Button.

S-816 TURBO C TUTORIAL VER 1 (DISK 1 OF 2)

TURBO C tutorial will teach an individual the basic structure of the c language. Turbo C is not really a beginners language so the author assumes you are familiar with other programming languages. The tutorial starts out explaining the C language and by the time you have completed the lesson you will be very familiar with Turbo C.

S-817 TURBO C TUTORIAL VER 1 (DISK 2 OF 2)

This is disk 2 of Turbo C tutorial. See disk S-816 for details.

S-819 CROSSWORD CREATOR VER 2.50

CROSSWORD CREATOR was designed primarily for educators, but can be used by anyone who enjoys designing or solving crossword puzzles. It provides the tools needed to lay out a crossword puzzle on the computer's screen, define a short clue for each word in the puzzle, and save the puzzle to disk so it may be used again and again. In addition to the design features, CWC has a "solve" mode where anyone can work with a predefined puzzle. CWC shows the layout of the completed puzzle, but does not display the letters themselves. By viewing the clues for each word and supplying the proper letters, the puzzle can be solved in exactly the same way as a traditional crossword.

S-826 ADVENTURE ADDICTION

This disk has a collection of five great text adventures. In UNDER THE ICE, you have been given command of the U.S.S. Helldiver on patrol for German Uboats. Suddenly, a high-priority coded message is radioed to you from the pentagon. The message says that a specially equipped B17 bomber has crashed near the north pole. Aboard the bomber was a VIP with diplomatic documents regarding the current and future joint war effort between us and the soviets. If these documents fall into the wrong hands we will lose the war. QUEST OF KUKULCAN is an Indiana Jones type adventure. You are an American archaeologist in pursuit of the lost city of kukulcan, a fabulous city which many think exists only in legend. You, however, tend to believe that it truly exists. All you have to guide you is an old, vague map of questionable pedigree. BRAMINAR is a fantasia type adventure game where you are on the trail of the evil overlord. Your quest is simple: reach level 20 or higher, find the staff of Aviatar and defeat the evil overlord. Sounds easy, but the game is set at a fast pace and there are many obstacles which stand in your way. One more thing...Beware of the ugly stick and the plague. In GYMNSDIUM ADVENTURE you have just finished a hard P.E. Session at school and are taking a shower. When you have showered and go to get your clothes, you find them missing from the locker room. Your quest is to find all your clothes and get dressed, but don't let Mr. Mean catch you without anything on!

S-828 EDRAW VER 3.2

EDRAW is a sophisticated graphics program which has the capability to draw schematics, block diagrams, flowcharts and can even be used to lay out a printed circuit board. The program features several text fonts which can be incorporated into any drawing or diagram. One serious drawback to EDRAW is the lack of documentation. No users manual is included in the shareware version. This limits the program's usefulness, as one is unable to easily use all of edraw's features. However, two demonstrations are included, which show many of EDRAW's capabilities.

S-832 BEYOND THE TITANIC AND KINGDOM OF KROZ

The game begins when you find yourself standing onboard the Titanic, on her maiden voyage. Your goal is to survive and somehow get back to your home in the United States. Most of your time is spent solving numerous problems and dangers that arise like starvation and drowning. If you've played any of infocom's famous text games you will notice that Beyond the Titanic is quite similar to zork and planetfall. To add to the game's realism, sound effects have been added to the game. In KINDOM OF KROZ you are in search of a priceless amulet that lies somewhere within the mystical kingdom of Kroz. Be careful, there are mysterious rooms and vicious monsters waiting for you. You are armed only with a whip and your wits.

S-836 DISK COMMANDO VER 2.10

DISK COMMANDO is shareware's answer to Norton Utilities. The DISK COMMANDO utilities have been created as tools in your day-to-day use of hard disks and diskettes. With these 17 utilities, you can re-optimize your disk drive, recover accidentally deleted files and subdirectories, sort the contents of a directory in any order, possibly recover disk information after a execution of a format command. Other utilities include a stopwatch function that allows you to time the duration of various processes, and a disk tester that will check for bad sectors and files. The individual utilities can be run separately or from a menu that includes a description and usage for each utility. Be forewarned that this shareware version uses flashing dollar signs in the menu in an attempt to get you to register the program..

S-841 MANDELBROT MAGIC

MANDELBROT MAGIC generates color displays of the mandelbrot set, a famous group of mathematical structures known as fractals. Fractal geometry is a complicated field in mathematics, but this program is easy-to-use and will automatically create the fractal slides according to your specifications. With this program, you can create a new slide, or create a slide from an existing one. A set of fractal slides will display a portion of the former slide in greater detail. One of the unique things about fractals is that they reveal more and more detail the closer you get, and the small scale details are similar to the large-scale details. Generating a slide is an intensive computational task and can take from 3 to 16 hours but an 87 math co-processor will reduce the generation time by a factor of 3 to 5. A 15 minute demonstration program is included on this disk.

S-842 BOX VER 1

BOX is a screen designing tool that lets you quickly create entry screens and menus. You start with a blank screen, and using simple commands you can draw lines, boxes, enter text, and change foreground and background colors. With this program you may repeat an entry, paint an area, and select special characters from an ASCII table. Boxes are incredibly easy to design, and several different border lines are provided to create them. Any screen may be saved in either ASCII, memory, or packed format. ASCII format allows you to save your screen so that it can be edited by a word processor, but it does not save color and the screens appear line-by-line on the monitor. With the memory format, screens are essentially a snapshot "dump" of the video memory buffer. This format saves the color, but it can not be edited by a word processor. You can, however, re-edit any screen with box. The packed format is the same as the memory format, except that the file is compressed. Any saved file can be loaded directly from a Pascal or C program. The packed file can be loaded using a Pascal screen loading procedure, but will take more time to access. This disk contains sample routines that you can incorporate in your Turbo Pascal programs.

S-844 ABC FUN KEYS VER 2.0

ABC FUN KEYS, an educational program, teaches the alphabet to children 2 to 5 years old. The program has colorful pictures for each letter, and many nursery rhyme melodies are played when the right key is pressed. The program consists of four related learning games and several game options structured around the alphabet. In the first three games a menu allows you to select the letters to be presented and the order of presentation (usually in alphabetical order). The letter appears along with a picture of something that begins with that letter, and the child must press the key associated with the letter. Pressing the correct key causes the computer to play a song, otherwise a buzz sounds. The fourth game is designed for very young kids. It displays the letter of any key pressed along with a random song. Both the pictures and the songs of this program have been developed on commercially available editors and can be easily expanded or changed by interested users. ABC Fun Keys is educational, yet designed to make learning as fun and as stimulating as possible.

S-846 THE LOTUS LEARNING SYSTEM DEMO (DISK 1 OF 2)

The LOTUS LEARNING SYSTEM is designed to teach the novice computer user how to use Lotus. The program starts by going over the menu and how it works. Then you choose the option you would like to start with (start from the top of the menu and work your way down for best results). From this menu you may choose spreadsheet background, applications for lotus keyboard features, access system, control panel features, trial balance model and more. I highly recommend this program for anyone about to buy, or who already has Lotus. This disk holds some sample worksheets for you to use with Lotus 123.

S-847 THE LOTUS LEARNING SYSTEM DEMO (DISK 2 OF 2)

This is the second disk of the Lotus Learning System. See S-846 for details.

S-868 PC-MAIL VER 2 (1 OF 2)

PC-MAIL is a mailing list manager that prints mailing labels, enters new addresses and deletes old ones. The sort function in this package alone makes it worth the money. With this you can sort on any field in a matter of seconds. All menu routines provide a listing of the options available. The program is fully menu-driven the author had the computer novice in mind when developing this program. Each program function opens with an introductory screen. This screen explains the functions served by this subprogram. Just follow the instructions on the screen and it explains what to do next. PC-MAIL is not just another mailing list program it is a fully-functional package which will assist you in your home or business.

S-869 PC-MAIL VER 2 (2 OF 2)

This is the second disk of PC-Mail. See S-868 for details.

S-870 HGCIBM 2.02

HGCIBM provides owners of Hercules graphics cards a means to run software written for the IBM color graphics adapter and to introduce a commercial version of the Athena Digital video BIOS which offers added functionality. This is the best CGA adapter emulator we have ever seen. HGCIBM runs 95% of all CGA programs. Fails with PC Magazine's ANSI.COM (Screen colour stays jammed on black on black! but DOS still works OK.)

S-878 TEACHER'S DATABASE

TEACHER'S DATABASE 1000 is designed particularly for teachers to organize information on their students. The database can hold up to 250 students each student having as many as 60 individual items of data in his record. This program can store names and addresses alphabetize or reorder records based on their contents sort by homerooms or subjects print individual student progress reports print class gradebook sheets and print student seating charts. Student test scores may be weighed averaged statistically analyzed changed to a percentage or changed to a letter grade. Graphs of student test results may be created using the computer's high-resolution graphic screen.

Grade distribution can be displayed numerically or as a histogram.

S-879 BIORHYTHM MONTHLY SCHEDULE PROGRAM

BIO can calculate the biorhythm cycles for any person born after the year 1753. After a birthdate is entered the program calculates the biorhythms of a specified month and year. The physical emotional and intellectual cycles are marked by letters in columns for each day of the month each letter showing how high or low that particular cycle is. An asterisk indicates a critical day for that cycle. BIOCOMP compares the biorhythms of two persons and will display the percentage of compatibility for each cycle. PROP is a universal proposal writer. It produces one-page typed proposals suitable for selling almost any product or service. It can easily be user-customized to meet your own particular needs.

S-891 WHEEL OF MISFORTUNE AND SOLITAIRE VER 1.20

WHEEL OF MISFORTUNE is a two to six player game in which players compete to guess a puzzle consisting of a word or phrase. Under the puzzle the category of the word or phrase is displayed. A turn consists of spinning the wheel or guessing the puzzle. The wheel is composed of 24 slots each of which contains money, bankrupt, free spin or lose a turn. The player who wins the most in the first three rounds of the game goes on to the bonus round choosing five consonants and a vowel. The player then has 15 seconds to guess the puzzle. If it is guessed the player gets $25 or else the player loses everything. SOLITAIRE is a computer version of the card game solitaire. This is the basic game but with additional features. You can undo your last card play select the number of cards to turn from the deck each time (usually 3) and ask the computer whether or not there are any additional plays that can be made in a certain turn. There are several cheating options that you may or may not want to use such as peeking at the first overturned card in each stack. The full version of the program on this disk allows you to turn the talon back over to the deck while the demo version does not. There is online help throughout the game.

S-911 MIX IT UP

NEVADA POKER: A simple one-player poker game in which you may discard 1 to 5 unwanted cards of the cards dealt to you. The payoff odds are shown at the top right corner of the screen and the winnings are shown at the bottom. PRO LOTTO is designed to help you win lotteries ranging from a 6/15 format through a 6/52 format. PRO LOTTO lets you store all the past numbers you have played and all all past winning numbers. When choosing a lottery number you can put in your own number or a number produced by random generation. MUTANT INVASION is a text adventure-type game program. The year is 2000 and the worst is almost over. You're within a dome that covers the city to protect it from the firesky at night time. You can no longer hear the screams of the outsiders yet you know they are very near. The outsiders have more or less gotten used to living outside the city dome out in the burn, but there's no food or water fit for consumption even for them. That's why they look and act so fierce and weird and why they're coming again now.

S-912 FLODRAW VER 1.0 (1 OF 2)

FLOWDRAW is a graphics editor that produces black & white full-page diagrams. It is designed to handle symbols quickly and easily and is ideal for documentations such a flowcharts organization charts system diagrams and other symbols-oriented documentation. The program combines text and graphics on the documentation. It is equipped with a basic graphics editor for lines and circles in addition to pixel editing. Flodraw comes with symbol libraries for flowcharts, hipo charts and electric diagrams. You can design your own symbols save them and combine them into new libraries or add them to an/the existing library.

S-913 FLODRAW VER 1.00 (DISK 2 OF 2)

This is the second disk of Flodraw. See S-912 for details.

TALKING ELECTRONICS Shop, (03) 532 0236
2 Central Ave., Moorabbin, Vic. 3192
FAX: (03) 583 1854

Name: . . . . . .

Address: . . . . . .

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Description of items etc:	$	
Please send the following IBM disks @$5.00 each		
plus $1.00 post per disk:		
	Pack/post:	
Bankcard	TOTAL $:	
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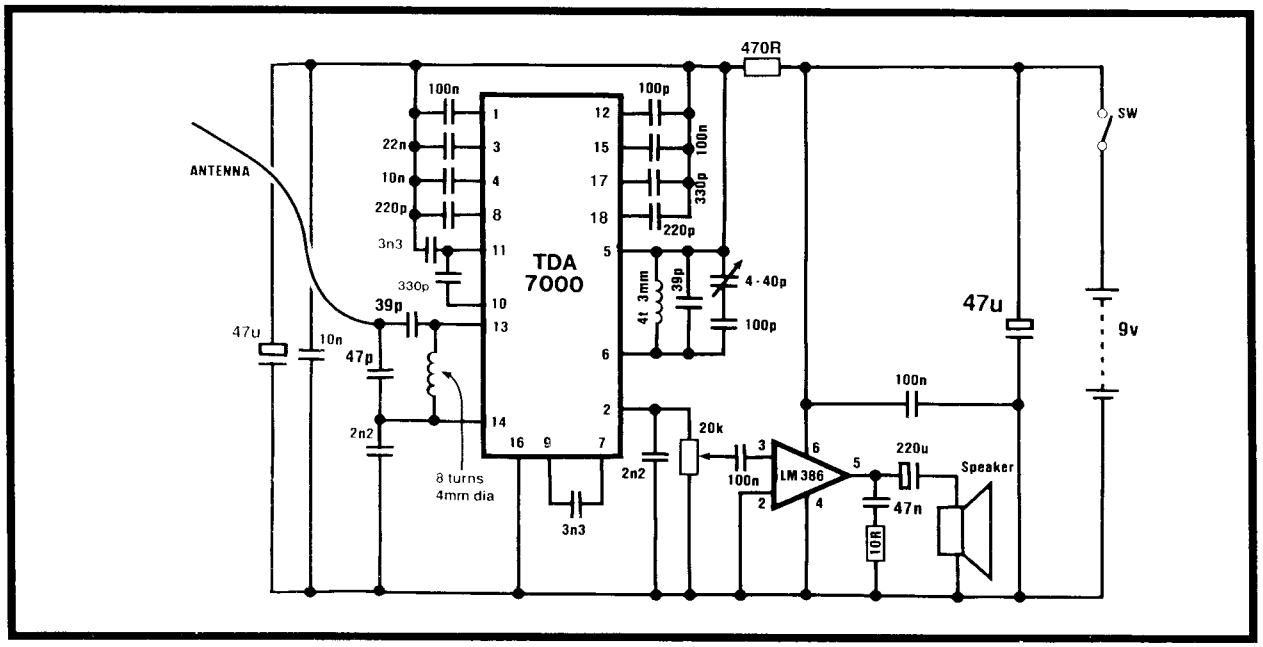
Send Credit card Number/MoneyOrder/Stamps for orders under $10.00/Cheques for orders over $10.00 or CASH. Minimum order $5.00

Credit Card No:

FM RADIO

A radio you can build into a cigarette pack

Parts $19.15
PC board $2.80
Total $21.95



FM RADIO CIRCUIT

This FM Radio has been designed to complement our range of FM transmitters. With an FM bug and an FM radio, you can produce an FM link.

The receiver described in this article uses two chips and is small enough to fit into a case about the size of a pack of cigarettes.

You can use either an earphone or small speaker as the output device and create a one-way link for a baby monitor etc. This will allow you to be in constant contact with a baby or sick child.

There are many uses for an FM link and I am sure this will fill the bill.

We have had many requests for such a link, from those who have built up one of our bugs, and here's our fully-tested design.

We made a number of simpler FM radios but they did not work satisfactorily. We started with a synchrodyne design but found it too difficult to tune in the stations. Then we tried another design similar to reactance in AM reception but found the whole arrangement too fiddly and susceptible to drift when being handled.

When a dedicated chip such as the TDA 7000 came on the market, we had to try it.

The results were most impressive. Using only a short antenna we could pick up all the local stations.

As with all radio designs, the most difficult component to obtain is the tuning gang. We would have liked the proper thing but since no one manufactures FM radios in Australia, we have had to settle for second best.

It's an air trimmer with an added knob in the form of a 5mm LED to tune the range 88 - 108MHz.

The advantage of making your own radio is the band can be broadened to 75 - 115MHz so that a private band can be created on either side of the commercial range. This is the area I suggest you choose as any transmission must not infringe on the commercial band.

PARTS LIST

1 - 10R 1/4 watt
1 - 470R
1 - 20k trimpot
2 - 39p ceramic
1 - 47p ceramic
2 - 100p ceramic
2 - 220p ceramic
2 - 330p ceramic
2 - 2n2 greencap
2 - 3n3 greencap
2 - 10n greencap
1 - 22n greencap
1 - 47n greencap
1 - 100n greencap
3 - 100n monoblock
2 - 47u 16v electrolyticS
1 - 220u 16v electrolytic
1 - 4 - 40p Philips trimcap
1 - 5mm LED for trimcap knob
1 - LM 386 Low Power Amp
1 - TDA 7000 FM Radio IC
1 - 8 pin IC socket
1 - 18 pin IC socket
1 - 4 turn 3mm coil
1 - 8 turn 4mm coil
1 - SPDT slide switch
1 - 8R speaker
1 - 9v battery snap
1.5m hookup wire for antenna

FM RECEIVER P.C. BOARD

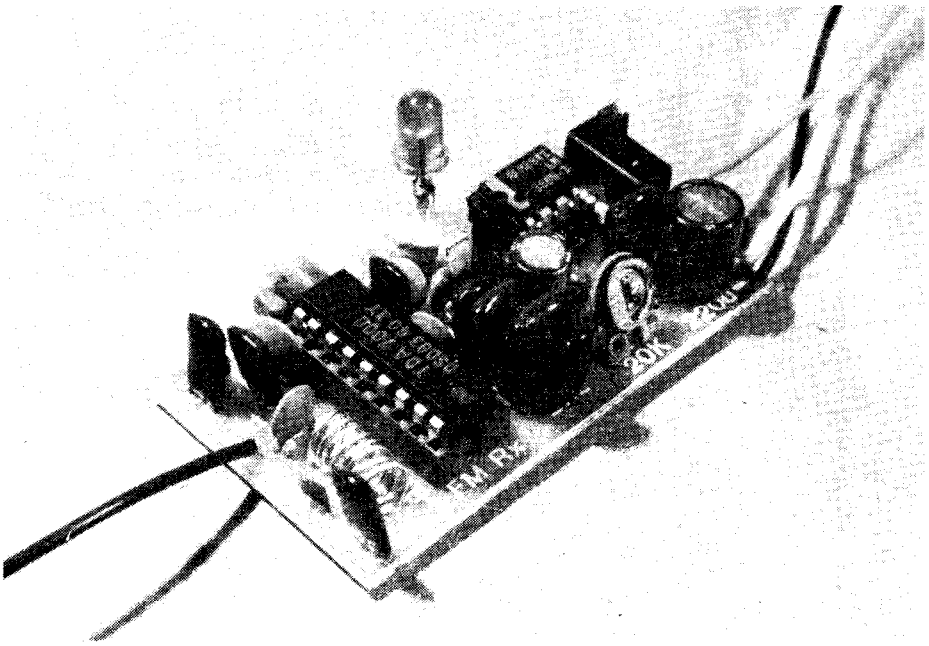
At the low end of the band there are courier companies and at the high end, airport traffic. No matter where you settle, you must not sit on top or near any other operator as this will not only limit your range but your transmission will be picked up by others. After all, who wants to hear a baby crying over the radio!

This circuit offers an introduction into FM reception and you will be able to determine the critical nature of many of the components.

The project should not be made on your own layout as the critical nature of the tuned circuits will prevent the radio from operating. At least that's what we found.

Essentially the tuning capacitor and 4 turn coil must be kept close to each other and the chip, for the tuned circuit to operate and you are advised to use our layout to be sure the circuit will work first go.

Once you have it working successfully, the oscillator coil can be adjusted to shift the band up or down. More about this later.



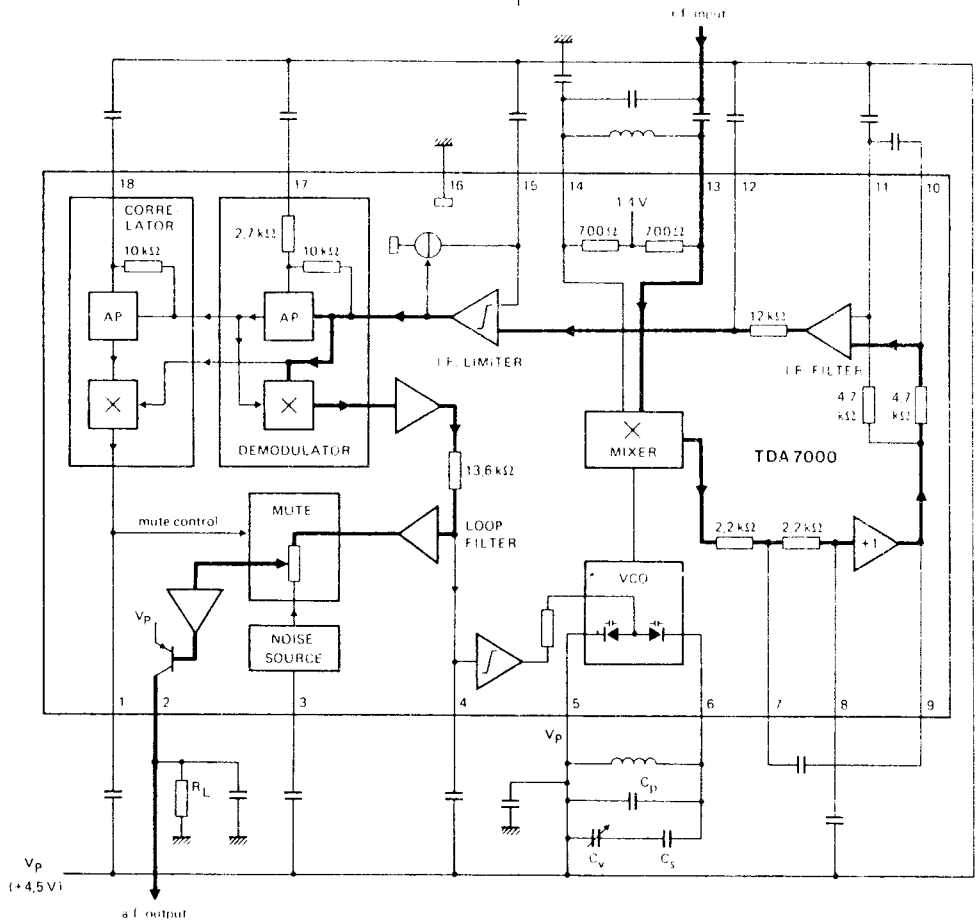
Note the 5mm LED soldered to the shaft of the air trimmer to act as a knob.

The upper limit of the chip is 115MHz so,unfortunately, you cannot tune the amateur bands.

With this project, as with many of our designs, we have not suggested a case to house it in. Although there are many plastic boxes around, we have not settled on one particular type as the availability of chocolate boxes etc will vary from state to state.

We are always on the lookout for suitable enclosures and sometimes the perfect answer pops up by chance.

Both the Tic Tac box for the Amoeba and Livil box for the Ultima came as a passing suggestion from a customer. Maybe there's something along the same lines for the FM radio?



Block diagram of the TDA 7000 chip. The signal path through the chip is shown in heavy lines. The capacitors around the chip correspond to those in our circuit.

CONSTRUCTION

Place the contents of the kit on a clean part of the bench and check that everything has been supplied. If there are any notes in the kit they will explain any changes that have been made since the release of the magazine.

Inspect the board for any shorts or cracks (we have changed PC board manufacturers and our latest batch of boards are absolutely perfect. Not a single hole has been forgotten and no holes are filled with solder.)

The first component to be fitted is the 10R resistor and goes near the on-off switch. Then the 470R resistor.

The 8 pin and 18 pin IC sockets are fitted to the board so that the notch covers the half circle on the overlay. This is important so that the chips can be fitted correctly at the end of assembly.

The capacitor and 2 electrolytics are next. If you have trouble working out their value, refer to some helpful hints on the back cover of the first issue of Talking Electronics.

The electrolytics are polarised and should be placed on the board so that the positive lead goes down the hole marked with a "+" symbol.

The 20k mini trim pot and the trim cap fit on the board only one way around. When soldering these in place, do not leave the soldering iron on the joint too long or the plastic parts will melt. An insulating handle is made for the trim cap by soldering the 5mm LED to the shaft. Cut the leads of the LED short and tin both LED and shaft. Bring the two together and solder very quickly.

If you have bought the kit from us, you will find the coils have already been wound. If not, the next steps will be important. Wind 4 turns of enamelled wire clockwise around a 3mm Philips screwdriver. Heat the ends of the coil with the soldering iron to remove the enamel and tin the ends. This will make it easier to solder it to the board.

Wind 8 turns of tinned copper wire clockwise around a 4mm Philips-head screwdriver and solder both coils to the board in the positions identified on the layout.

The antenna, switch, battery snap and speaker and the next items to be added. The speaker is fitted via two 10cm lengths of hook-up flex and the antenna is 100cm of hook-up flex. Paint one end of the slide switch with red nail polish to identify the "on" position.

Fit the two chips into their sockets and give the board one final look-over. If all is in order, connect a 9v battery and turn the trim cap to pick up a station.

To move the whole band higher, squeeze the turns of the 4 turn coil together. To move the band down, separate the turns slightly.

IF IT DOESN'T WORK

If the radio doesn't work, you will have to decide which section is at fault. There are basically two sections. The FM stage and the audio stage.

Turn the volume control to mid position and touch the centre leg with a screwdriver. You should hear a click or hum in the speaker. If nothing is heard, the audio section is at fault.

Measure the voltage across the chip (pins 6 & 4) and the current taken by the circuit (approx 50mA).

If these readings are correct, you should make sure the speaker is wired correctly and the output electrolytic is soldered in place.

The voltage on the output pin of the chip should be half rail voltage (4.5v).

If this does not solve the problem, the only other possibilities are the IC socket being faulty or the chip being damaged.

Make sure you do not connect the battery around the wrong way as the chips will be damaged instantly.

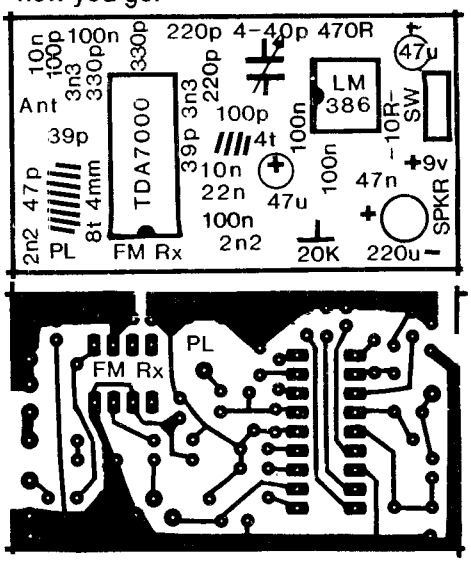
If a click is heard in the speaker, but no audio comes from the radio chip, check all the capacitors for correct value. These are the main external components for the chip as they are difficult to fabricate on the silicon substrate. If you pull the leads on a ceramic, or take too long when soldering, the connections inside the capacitor can come adrift. The only solution is to replace the capacitor.

Make sure the turns of the 8 turn coil are not touching each other. Measure the voltage across the chip (9v) and see that the chip has been inserted into the socket with all pins making contact.

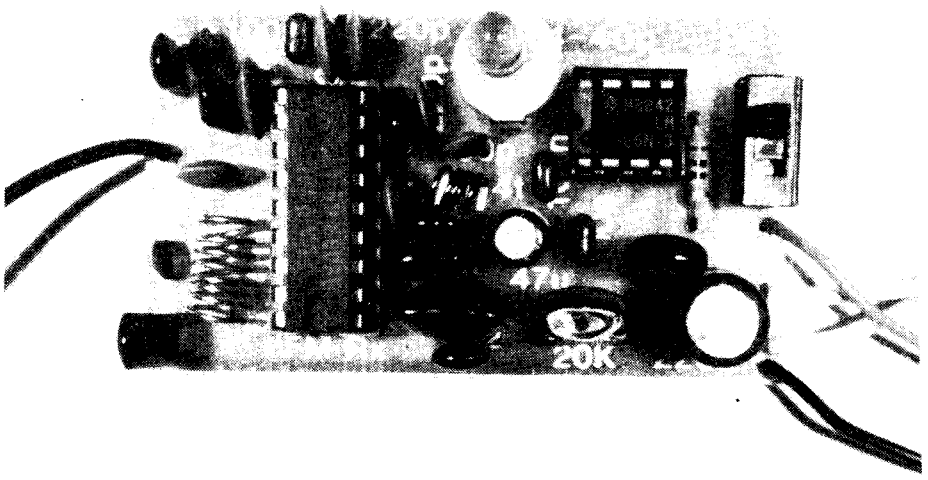
There is really little else you can do without test equipment. The only trouble we had with our first prototype was the tuned circuit with the 4 turn coil. The capacitor must be close to the coil and chip for it to work and it is important to use the coil as supplied in the kit to be sure the circuit will work.

We will leave housing the radio to you. The antenna can be cut shorter if the radio stations are strong.

Try the radio with the Ultima and see if you get the same range as a commercial receiver. Let us know how you go.



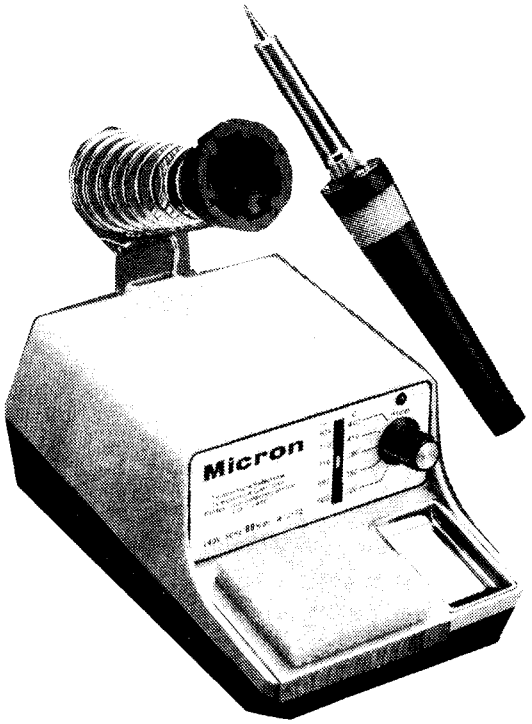
All kits for this project have 2 extra components (470R & 47u) to prevent instability. These are shown in the circuit diagram. The photos are our earlier model.



Plan view of the completed FM receiver showing the placement of all the parts on the board. Make sure the chips are inserted correctly as shown in the photo, with pin 1 of each chip covering the dot on the overlay

MICRON T2440
NEW DESIGN
Electronic Temperature-Controlled Temperature-Selectable Soldering Station

The MICRON T 2440 soldering station, offers the ultimate in controlled temperature hand soldering. 320°C, 350°C, 380°C, 410°C (608°F, 662°F, 716°F, 770°F and 824°F) fixed temperatures are selectable by rotating the detained rotary switch freely without changing heater or tip.



Comes with free hank of solder.

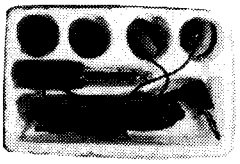
$110.00 P & P $8.00

200g roll of solder $5.50

PROFESSIONAL MICRO DYNAMIC STEREO HEADPHONES

Equipped with 13.7mm mylar speakers.
Maximum input power - 50mW
Impedance - 32 Ohms
Frequency Response - 30 to 20,000Hz

$5.00



DANCING FLOWER

Place it near a radio or stereo and watch it dance to the music.

$29.00

REMOTE CONTROL CARS –SET OF TWO

Each car on a different frequency so they can be raced together. Scale 1/10th

$120.00 per set

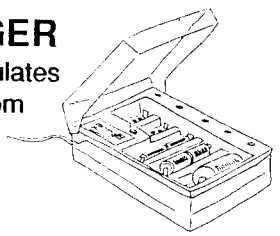
INDOOR FM-VHF-UHF ANTENNA

High quality performance at an affordable price. Ideal for colour television.

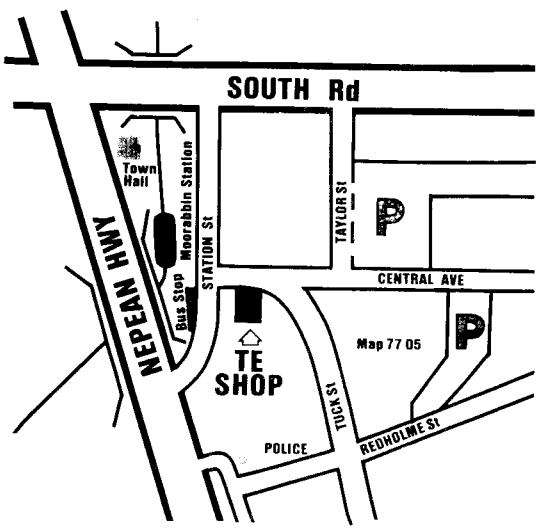
$18.00

NICAD BATTERY CHARGER

Advanced circuitry. Automatically regulates charging rate. Will charge batteries from AAA cells through to 9v.



$25.00



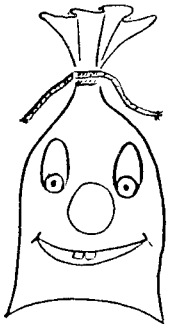
TALKING ELECTRONICS SHOP

2 Central Ave., (off Station St.,)
Moorabbin, Vic. 3189
Tel: (03) 532 0236
Mon-Fri: 9.00 - 6.00 Sat: to 4.30

A BAG OF LAUGHS

An ideal gift for those who find it hard to control their temper. Just punch it in the nose and it will laugh.

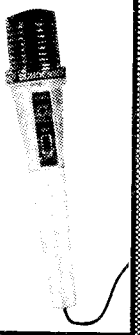
$15.00



FM WIRELESS MICROPHONE

Adjustable between 88 and 108MHz and will transmit up to 50 meters away. Use it to practice speech, singing, or for party announcements and speeches.

$12.50



TELEPHONE EXTENSION CORD

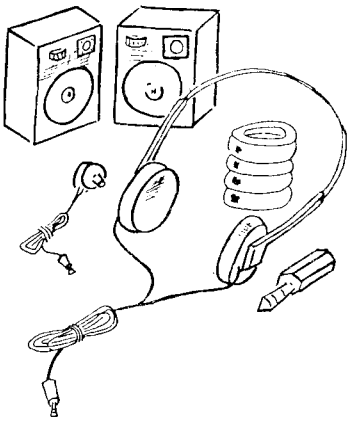
5 metre extension cord with double adaptor. A short cut for installing an extension phone.

$5.50

THE MUSIC CENTRE

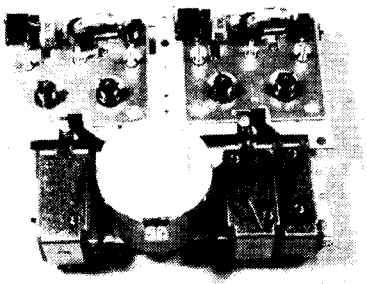
Experimenter stereo speakers and headphones. Includes one mini stereo speaker box, one pair of stereo headphones, one mono earphone, and one 3.5mm to 6.4mm stereo plug adapter.

$7.00



MICROCASSETTE RECORDER MECHANISM

A dual microcassette mechanism that can be electronically controlled to achieve a dual microcassette player/recorder. Each transport mechanism is controlled via 12v solenoids and has separate record/play heads. A really beautiful design, just waiting for computer control.



$9.00

MOVEMENT DETECTOR MINI ALARM

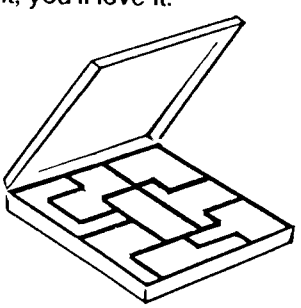
This detector signals movement both day and night within a predetermined area. The built in passive infra-red detector registers the smallest temperature change relative to the current room temperature. The unit is a stand alone unit and has two modes of operation. One mode will sound the alarm continuously at the slightest movement. The other mode will only sound the alarm for approximately two seconds.

$59.50

MAGIC BLOCK PUZZLE

Made up of eight different shaped pieces that can be assembled in 48 different combinations to form a square. See how many combinations you can solve. It's not as easy as it sounds. Try it, you'll love it.

$7.00



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Postage and Packaging Prices

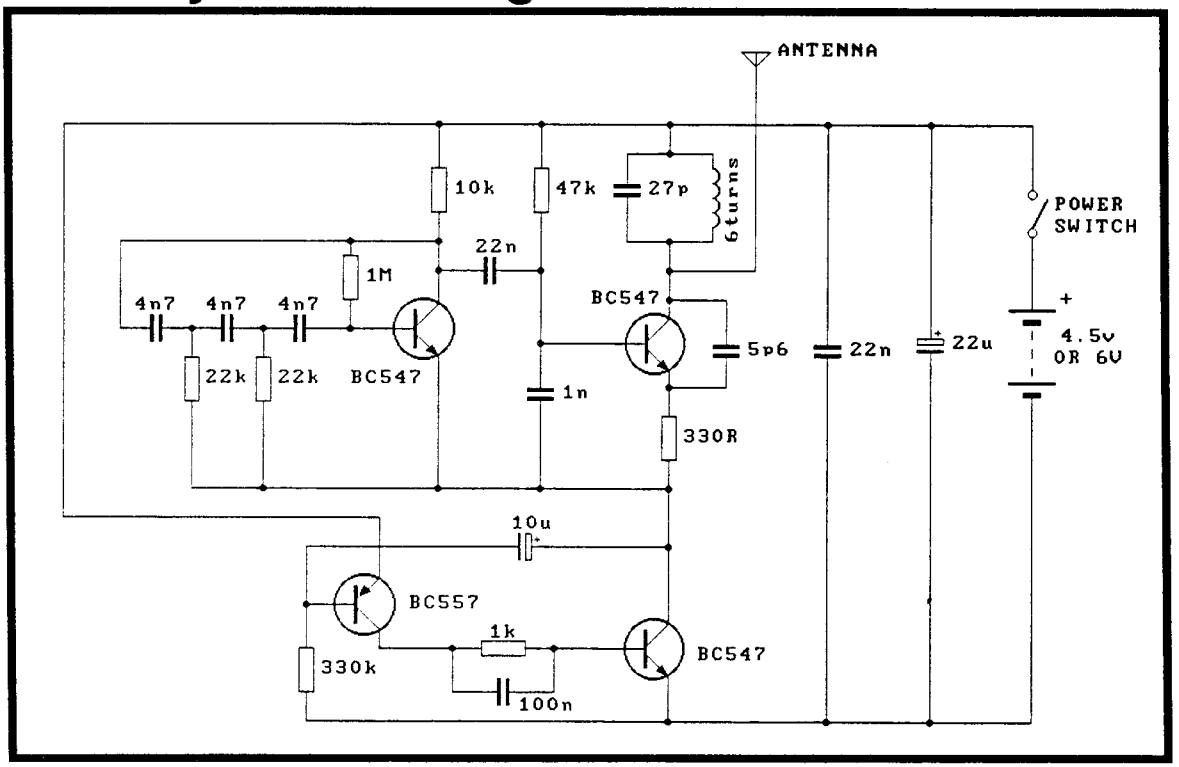
	VIC.	INTERSTATE
Orders up to $9.99	$2.50	$3.00
$10.00 to $19.99	$4.00	$4.50
$20.00 to $49.99	$5.50	$6.00
$50.00 to $99.99	$6.50	$7.00
$100.00 or more	$7.50	$8.50

BEEPER BUG

It lets you find things . . .

Circuit design by Richard Borg

Parts $5.10
PC board $1.80
Total: $6.90
You may need the peaker and/or Field Strength Meter.



BEEPER CIRCUIT

This beeping bug can be attached to anything from a glider to a pot plant and you can track it with a radio.

Why track a pot plant? Read on to find out.

The Beeper is the result of many requests for a mini tracking device and brings a new world of tracking to your fingertips.

The circuit is very compact and consumes almost no power. It is small enough to be hidden in anything you suspect will be lost or stolen.

By using a mercury switch or grasshopper, the bug can be "primed" for the time when it is moved and you can track it down with an FM radio.

A grasshopper is a switch that is ready to go off at any time. A piece of plastic is placed between the two switch contacts to keep them apart and connected to cotton thread that is fixed to the floor. When the object is moved, the cotton pulls the plastic out of the switch and the bug is turned ON.

One caller suffered the constant theft of pot plants from his verandah and wanted a bug to track the thief.

Another had chemicals stolen from his warehouse and the cleaner was the prime suspect. But to prove things like this is always difficult.

Something small enough to hide in a case of detergent bottles was needed and that's where we came into the picture.

The most notable theft occurred from a video taping factory where packs of tapes were leaving by the back door, some time during the night shift.

If this bug had been developed a few months earlier we may have caught a thief at our own premises.

We have had thousands of dollars worth of goods stolen by a worker over a period of 6 months and this included made-up bugs and mountains of parts.

It was not until we caught him red-handed that we believed it possible.

PARTS LIST

1 - 330R
1 - 1k
1 - 10k
2 - 22k
1 - 47k
1 - 330k
1 - 1M
1 - 5p6 ceramic
1 - 27p ceramic
1 - 1n ceramic
3 - 4n7 ceramic
2 - 22n ceramic
1 - 100n monoblock
1 - 10u 16v PC mount electro
1 - 22u 16v PC mount electro
3 - BC 547 transistors
1 - BC 557 transistor
1 - 6 turn, 3mm dia coil enamelled wire
1 - SPDT mini slide switch
3 - button cells*
1 - 1.7 metre wire for antenna
1 - BEEPER BUG PC BOARD

*See text for 3v lithium cell option.

Right under our noses, pockets full of parts were being removed each time the worker went home.

As I have been saying for years, every business is suffering to the tune of more than 15% from theft and this is being passed on to customers, through constant price rises.

A bug like this would make an ideal detector to track down anything going astray. By attaching it to the product under surveillance, you can follow its removal and maybe turn up quite a few surprises.

HOW THE CIRCUIT WORKS

The circuit consists of three blocks and each has been covered in previous projects.

By putting them together, we have produced a very compact beeper using 4 transistors and a few other components.

The first building block we will cover is the phase-shift oscillator. It produces a sine-wave output and is turned on for a very short period of time by a 2-transistor pulse generator made up the two lower transistors. At the same time the 88MHz carrier oscillator is turned ON and the tone is superimposed on the carrier to get a brief BEEP.

The two stages are coupled via a 22n. The frequency of the RF oscillator is determined by a number of things but mainly the value of the capacitor and inductor in the parallel tuned circuit. The final building block is the pulse circuit made up of a feed-back amplifier using a BC 557 and BC 547.

The circuit starts its cycle by charging the 10u via the 330k resistor. If you can't see how this occurs, remember that a capacitor and resistor in series form a delay circuit and it does not matter if the resistor is the top component or the lower component.

As the capacitor charges, it brings the base of the BC 557 towards the negative rail and this turns the transistor ON.

This effect is passed directly to the BC 547 via the 100n capacitor (and 1k resistor) and the BC 547 turns ON.

The voltage on the collector of the BC 547 falls very quickly and brings the 10u down with it.

The small voltage across the 10u forces the base of the BC 557 lower and turns the transistor ON even harder.

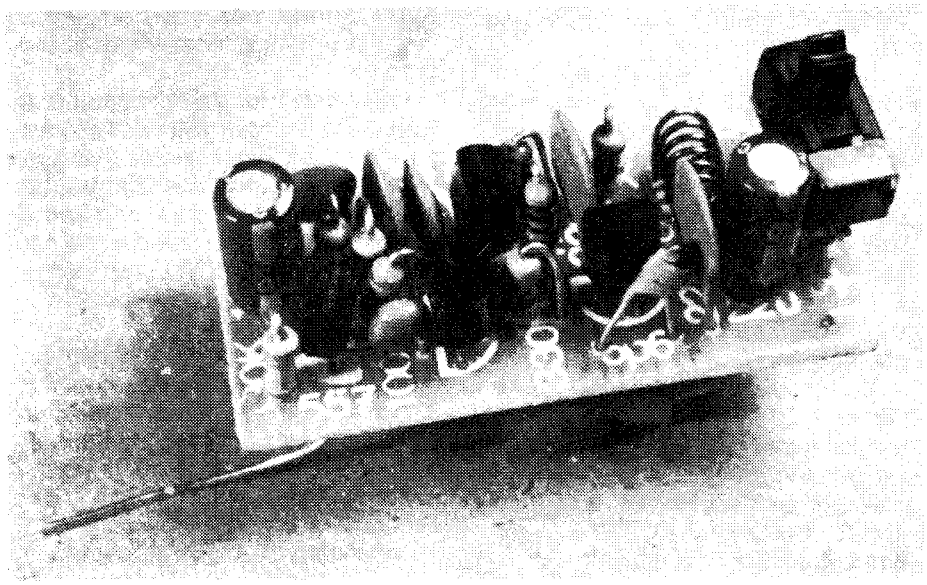
Both transistors become turned on fully and the energy in the 10u feeds the BC 557 until it is all used up. The 330k resistor can no longer keep the BC 557 turned on as hard and it turns off slightly.

This effect is passed to the BC 547 where the collector voltage rises slightly and the rise is transferred directly to the BC 557 via the 10u and the circuit starts to move in the other direction.

Both transistors become fully turned OFF and the 10u begins to charge again via the 330k.

The circuit takes almost no current between beeps and the duty cycle of the tone is about 10%.

This makes the circuit very economical on batteries and you should get many hours of operation from a set of three cells.



A close-up of the Beeper Bug showing the placement of the parts.

CONSTRUCTION

All parts fit onto a small PC board and by using miniature components, the size is kept to a minimum.

Keep this in mind when collecting the parts. If you use old-style parts, they will not fit. The safest way is to buy a kit. All the components in a kit have been selected for their size and reliability and these decisions would take a whole page to relate.

All the parts must be kept close to the board when soldering so that they are not too high as they may upset the frequency.

All the resistors stand-up on the board and the easiest way to carry out construction is to start at one end of the board and fit each part as you come to it.

The overlay makes it easy to see where everything goes and the only two things you have to be careful with are the BC 557 transistor (don't confuse it with the BC 547's) and the polarity of the electrolytics. Don't forget to tin the ends of the oscillator coil to get rid of the enamel before fitting it to the board. The on/off switch can be mounted on top of the board with short lengths of wire or fitted directly by drilling the 3 holes larger.

The supply comes from 3 button cells and these are soldered together very quickly to prevent the cells getting too hot.

Finally a length of antenna wire is soldered to the last remaining hole on the board and the project is ready for testing.

TESTING

With the power switched off, connect a multimeter across the switch terminals and you will see the needle jump very briefly to indicate the circuit is beeping.

You will not be able to detect the average current as the duty cycle is

too short, but you can see it is microscopic by the minute movement of the needle.

Next test the current consumption and the frequency of operation. Remove the 10u and re-test the current. It should be about 5-8mA and this shows everything is operating.

Switch the unit ON and place the antenna as it will appear on the glider or pot plant etc.

Tune an FM radio to 108MHz and expand the turns of the coil until the tone is detected. Keep the radio away from the transmitter to prevent picking up harmonics (side-tones). Replace the 10u and the project is ready for installation.

IF IT DOESN'T WORK

If the Beeper doesn't work you will have to determine which blocks are not functioning by comparing with the following symptoms:

If the circuit gives out a constant tone, the pulse section will be faulty. If a clicking sound is emitted, the tone oscillator will be faulty. If no signal is picked up at all, the RF oscillator section may be faulty.

Firstly check the current consumption. If the needle "jumps" but no RF is detected, the oscillator may be off the FM band.

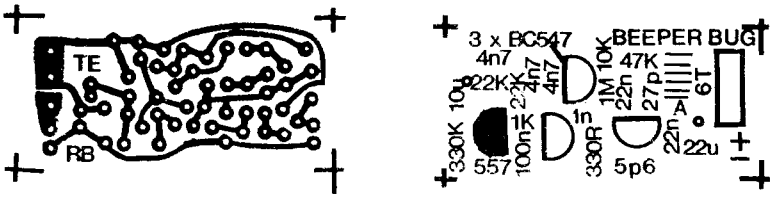
You should use the Field Strength Meter or peaking circuit to find out if RF is being emitted.

If RF is detected, you should check the value of components around the oscillator section and the number of turns on the coil.

The spacing of the turns is also critical as is the diameter of the coil. The kit comes with a pre-wound coil (6 turns @ 3mm dia) and the holes on the board will give you some idea of the spacing of the turns.

If you have made the coil yourself, check the dimensions carefully, they are most critical. Removing the 10u will cause the tone to be emitted continually and if a carrier is detected, (blank spot on the dial) but no tone, you should check the voltage on the collector of the tone stage. It should be about 3v. A CRO will be the easiest way to see the output however an audio amplifier will be just as good.

Take the emitter of the transistor directly to negative rail (to remove the pulse section) and check the soldering on the phase-shift components (4n7's and 22k's) to make sure a dry joint is not present.



Artwork for the Beeper Bug. The board is very "tight" to keep the project small. Une only miniature components and mount them close to the board to make sure the project works as well as ours.

If you are still having trouble, buy another kit and build just the tone section (don't forget to take the emitter to negative). Alternatively, build the circuit on bread-board and detect the tone with an audio amplifier.

The amplifier can also be used to make sure the tone is passing through the 22n stage-coupling capacitor, to the RF stage.

As we have mentioned above, if RF is not detected the fault will lie in the oscillator stage.

The components making up this stage are the 47k, 1n, 27p, 6 turn coil, BC 547 transistor, 5p6, 330R and 22n across the battery.

The capacitance of the circuit will have an effect on the frequency as will the battery condition, the earthing effect of your hand, the length of the leads to the battery and switch and the length of the antenna.

Once you get the circuit working you can change things around but keep everything compact at the start.

In the pulse circuit, short the collector of the BC 547 to the emitter to make sure no fault is being introduced here.

The RF circuit has been covered many times before in the other bugs and you should refer to them if you are having trouble.

Finally we come to the pulse circuit. It is simply a high-gain, DC coupled amplifier.

By removing the 10u, the circuit will turn ON. The voltage between the collector and emitter will be small (about .5v). If not, short between collector-emitter of the BC 557. If the circuit turns ON, the BC 557 is faulty. If not, the BC 547 is faulty.

Shorting across the 10u with a jumper will turn the circuit off and the voltage collector-emitter of the BC 547 will rise to about rail voltage.

If the circuit doesn't work when the 10u is fitted, the problem may be a leaky electro. Try another and experiment with different values.

Everything has now been checked and the circuit should be working perfectly.

OPTIONS

The kit comes with 3 button cells but you can order lithium cells for an extra $3.00 each. By using 2 lithium cells (6v) the output will be increased by more than 300% and this will give considerably better range.

The circuit has been designed to operate at the high end of the band (108MHz) and if required to operate at 88MHz, the tuning capacitor (27p) should be changed to 47p. Our tests showed the output at this frequency to be less than at 108MHz, so decide carefully.

FITTING THE BEEPER

The Beeper can be used for many applications and its range will depend on the effectiveness of the antenna.

Obviously a long straight antenna will be the best but you can't always get what you want when trying to hide things. A long fine wire will be better than a short thick one and if you want to hide the Beeper in a pot plant, for example, you can drape the wire over the branches like a thread.

If it is to be used in a glider, the main struts can be the antenna. If it is to be hidden in a box of tissues, or something similar, the antenna can be taped to the insides of the box.

To get the best range, you must experiment before placing the bug on location and when it's all working perfectly I'm sure you will be very pleased with the performance. .

INSIDE TALKING ELECTRONICS

This is a story on the workings of Talking Electronics.

There are so many things we could talk about but this time I want to bring you up to date with the range of products we have developed.

We get lots of requests for assistance on the best way to get into electronics and which study path to take. There are so many ways that it would take a book to cover them all.

But because I have been engaged in a number of different areas in the past 20 years, I can give a fair amount of assistance.

The fact that electronics is the fastest growing industry should give you a warm sense of surety and provided you keep pace with technology, you should have no trouble finding an area that you like.

You can even combine two hobbies at the same time, like cars and electronics, aircraft and electronics or medical and electronics to name a few.

But let's get back to the aim of Talking Electronics. It was set up about 8 years ago to cover the basics of electronics in a way that has never been attempted before - via construction.

The only way to learn electronics is by doing it yourself. It's only when you have to troubleshoot a project that learning takes place.

I can remember how I fixed a particular fault in a black and white TV set some 15 years ago but I can't remember any of the articles I read that year!

When you work things out yourself, the results stick in your mind for ever. That's why our approach is so successful.

Up to now, we have covered a number of different areas: Digital, Audio, Microprocessor and FM transmission. We have also shown how interesting each area can be. You could spend a whole lifetime on any one and never finish learning about it.

I know a friend who spends his whole waking hours with speakers. Selling speakers, listening to speakers and providing a re-cone service for those who wind the wick up too far.

If you can become as dedicated as this with the humble speaker imagine what you could do with a more interesting component!

One suggestion I would like to make is for you have more than one string in your bow. You should learn about a number of topics and even though you may not see the need for this at the moment, it will be appreciated later.

Quite often a design expands into a number of areas and this is why it is essential to have a broad learning base.

Our intention is to start you in a number of fields and if you have read a few of our books you will be interested to know what we have covered.

THE DIGITAL SIDE

If you have never experimented with an IC before or built anything that goes "flash-flash," we have a range of more than 20 kits designed to demonstrate the concept of digital electronics.

The idea of an output (or any line for that matter) being HIGH or LOW (and not any value between) seemed to have no practical use to the radio buffs in the old days.

TE Publications build up to be a reference library. You need them all to get continuity.

But it's digital technology that has brought us the LCD watch, the split screen VCR, DAT and many more related devices.

The fact that every line in a digital circuit is either high or low makes it very easy to service.

Voltages are easy to read and if they occur for a very brief period, test equipment is available to detect them.

Unbelievably, digital circuits are much easier to service than audio and this means enormously complex designs can be serviced by relatively inexperienced personnel.

From simple digital projects we advance to a microcomputer project that demonstrates the power of programming. You can write your own machine code programs and create timers, delays, clocks, active displays, games and simple artificial intelligence programs for robots and the like.

As a fore-runner to digital principles we have produced a book titled STARTING IN TTL and it covers the first lesson in counting, shifting and storage. A trainer kit comes with the book and it starts you from "ground zero" to the end of lesson one via a set of 20 experiments.

Although a gap exists between this lesson and the microcomputer, you will quickly see that if a counting project is required, the simplest way to tackle the design is via a microprocessor.

This is where our next microcomputer comes in. It's a single chip design using the latest technology and our forthcoming book will show you how to develop your own software and be right in the fore.

To give an example of its power and the demand for programs, a small board to operate a washing machine, dishwasher, heater or microwave oven commands an incredible $15,000!

If you have always wanted to do this but don't know where to start, here's the path I suggest: Begin with the book "Starting in TTL" and buy the kit. Next build up the Clock kit, LED Dice Mkli, Lotto Selector, Logic Designer, Logic Probe, Logic Pulser, Continuity Tester and then the TEC-1B computer.

There are a few add-ons for the computer to allow you to interface to external devices and you should really spend 100 hours or more, creating simple programs so that you understand the power of programming.

It's so powerful that it puts you in charge of the project.

When you can honestly say that you can feel this power, then and only then, can you exit the first stage and knowledgeably launch into our new 68705 single chip project.

From there you will never look back. The power you will have will be incalculable.

We already have over 1,000 readers that are up to this stage and by following our method you can be guaranteed success.

But you must do your part by reading the books, buying the kits, carrying out the construction and following through with your own experimenting.

THE AUDIO SIDE

We are not heavily into the audio side of electronics and have only presented a few audio projects.

The trend in amplifiers is to go to FETs and it's nothing to deliver 100, 500 or even 1,000 watts into a set of speakers. This sort of equipment is very expensive and revolves around 240v mains etc. This has put it out of our class for the moment and only the simplest of amplifiers have been presented.

Our 4 watt Simplicity amp, 8 watt power amp and simple pre-amp will get you

started and from there you will have to contact a study course or see some of the monthly magazines for projects.

The most important part of amplifier design is keeping distortion to a minimum while supplying the wattage.

Its measurement requires constructing the amplifier and taking readings. All this is very time-consuming and quite complex. It brings you into the field of an Audio Engineer and if you want to complete the amplifier system totally and make it presentable, you will need to design the cabinet, speaker boxes and front panel.

In other words you will have to be a consumer orientated person as well!

TRANSMITTERS

Our range of FM transmitters has sparked an enormous interest from the general public.

Maybe it's the intrigue of spying on others, or the amazing performance of such a tiny device, that have soared our sales.

No matter what the reason, our intention was to expose and explode the myth that FM bugs need be expensive.

We changed the whole market place and devices that originally sold for $200 or more suddenly sold for $50, via us.

Nothing has out-sold our units or outperformed them and it is our intention to bring out more projects on the security side of electronics.

One idea generates another and we have a line-up of many more projects to come.

As we expand the range, the potential for providing a service to others must have crossed your mind.

The security market has always been a low key area due to the ineffectiveness of most of the alarm systems on the market.

This has been primarily due to the number of false alarms that have occurred. It has come to a point where no-one takes any notice of a wailing alarm and most of the systems have numerous shortcomings.

As improved designs come along, the market will open up as insurance companies are now allowing a discount on premiums where the premises have an effective alarm installed.

Although we don't have our brilliant alarm circuit finished at the moment, the time is still ripe for you to consider providing a security service for customers.

You may like to rent a shop or office and while this area of sales is still in its infancy, you will need to supplement it with general sales and maybe a small amount of simple servicing.

The law prohibits me from encouraging you to open your house or garage as a workshop or sales area but this is the only feasible way to start, in my opinion.

If things get bigger, you can move into a shop but I suggest you start off small and operate on a part-time basis.

This is how you can reap the rewards of your efforts and help others by providing a service at reasonable cost.

There is also quite a market in personal security/listening devices/recording devices etc.

Some of them can be made from kits while the more sophisticated units are available at discount price to resellers.

This market is very rewarding, both money-wise and personally, as nothing else is available at the price and you rarely fail to make a sale.

If we can get a few readers each week to enter their own business, we have been a success.

Don't let an opportunity pass by. But firstly you have to do your homework and get to the standard that will generate respect and create repeat business.

We have presented a number of paths quite clearly and it's up to you to see the potential.

Naturally we want to sell technical information to you but more important we want to see the advancement of electronics in general and see it being sold at the right price. I don't think $15,000 for a program or $200 for a mini bug like our Voyager is fair, so we want to promote you in our way of thinking and not encourage greed.

TAFE courses are value for money but expensive courses are a rip-off.

There's plenty of work for everyone because, as I said, electronics is expanding at a phenomenal rate and within 10 years we will have twice the amount of electronics in the home, on a per capita basis.

If you can see further into the future than me, so much the better but our aim is still to bring a lot of students up to the level of competency to start designing with present technology rather than promote a few into tomorrow's world.

I am a realist and not a venturist. My aims have always been achievable and that's why I am confident in presenting these discussions.

If you are not sure what we have to offer, you can send in a bank card, cheque or Money Order for $55.00 and ask for our complete range of books. You will get as many as the funds allow. You may think this is expensive, but believe me, it will be the best money you ever spent.

Let us know what books you already have and we will complete the set.

Some publications are out of print and only photocopies are available, while others will be re-printed soon.

If you don't want to spend quite that much, our set of Notebooks (1-5) cost $20.25 posted, and is an excellent place to start.

Correspondence courses are also available from most large TAFE colleges and their cost is surprisingly low. You can work at your own pace and carry out the practical work at home or at the college. A training kit is provided with some courses and the deposit is refunded at the end of the course, when the kit is returned.

The one area we do not recommend is the range of electronics courses provided by the large commercial institutions.

At $1,500 to $5,500 they are a blatant rip-off and the material I have seen is nothing short of appalling.

You are just paying their enormous advertising bill and getting nothing for your money. Those customers that have written to me and told their story makes me shudder how a large operation can treat their students.

One student paid his $500 deposit and only got the first two lessons. He waited 3 months for the next section and it took 3 letters to get any response.

The only course I can thoroughly recommend is the course from The Australian Digital Electronics School.

For $150 you get 6 lessons and 6 kits. It is a beginners course and shows you how to solder, how to test circuits and covers a number of building blocks. See their advertisement on the back cover of the Notebooks and also in some of the issues of TE.

The course costs more than $150 to produce but Talking Electronics subsidises the printing and supplies the paper at no cost.

I can't much more except I hope I have encouraged you to start your own business, or in some other way, use your skills to their full.

We have received a few letters from readers wishing to do this and a start-up kit is available for shops, consisting of the most popular books and kits. We have everything you want - it's just a matter of phoning and asking.

Remember, the only way to success is to spend time and money.

Time comes in the order of 30 or more hours per week and money comes in the form of a few hundred dollars buying parts, equipment and books. There's no other way.

Letters.

We enjoy your letters. Let us know what you want. That's how we get ideas for the projects.

We get a lot of letters and comments on the magazine and it's unfortunate we can't fit them all in.

Many readers request specific designs for this or that and modifications for overseas projects. I don't think they realise the cost of providing such information.

At normal rates, a Voyager design would cost about $1,000 so it's obvious we can't provide any sort of designing for free.

I know we portray ourselves as being cheap but we sell thousands of kits and a dollar profit on each covers our costs.

In fact we are unable to provide any sort of designing at all as we are fully committed for the next two years.

Other writers have been very helpful and we have got a number of ideas for designs from them. But the first letter is amazing. Ted (I can't use his last name) has predicted so many ideas that you would think he writes the magazine. Great minds think alike!

He writes: *I haven't earned a living in the electronics field since 1972 so naturally am very rusty on the subject, but the information you give on your projects is so clear that I am sure every body could follow the instructions.*

The first book of yours that I purchased was "FM Bugs." I nearly collapsed in shock when I read the title - and so curiosity led me to buy it.

I especially congratulate you on your useful little points - even after 25 years in the business they would not have occurred to me.

For example - on P 29 (More FM Bugs) you comment on piezo diaphragms. It would have never occurred to me to go to a card shop and buy a musical birthday card! Brilliant!

Another idea on P 33 - using a mono plug in a stereo socket to act as a switch as well as an input.

Referring to your ANT circuit, I don't see why you have specified two different types of wire for the coils, .71mm tinned copper wire and .61 enamelled wire.

I do recollect such things as "skin effect" and "RF resistance" but surely the requirements are not all that exacting.

Suffice to say that I made my first ANT exactly to specs and it worked great.

Regarding the Peaking Meters: As you mention on P 18 of More FM Bugs, the peaking circuit does not provide a true load and hence the output of the Amoeba may be decreased when the antenna is connected. For that matter, the antenna itself may not be a true match, depending on the frequency selected, and other variables.

Might I suggest, as a future project, that you consider adding a tuned circuit to your Peaking Meter and put it out as a Field Strength Meter. That would enable us to tune the bug with antenna attached and also try small variations in antenna length.

Further, regarding the peaking of the units:

During the 50's and 60's I worked on aircraft UHF sets, operating at frequencies just above the existing commercial FM band.

MANY OF OUR PROJECTS ARE THE RESULT OF READERS REQUESTS. READ HOW THE WRITERS HAVE PREDICTED SOME OF THE PROJECTS IN THIS ISSUE.

The output circuit was tuned exactly the same way as you tune yours - squeezing the coil, and also the coupling coil to the antenna had to be adjusted. Naturally everything interacted.

We used tuning wands (about the size of a needle) with copper at one end and ferrite at the other, sleeved in spaghetti.

If the output increased when the copper end of the wand was inserted into the coil, the circuit was inductive and the coil had to be opened up.

If the output increased when the ferrite slug was inserted, the circuit was capacitive and the coil had to be closed.

Maybe you could make or design something similar?

I plan to make an FM link in the near future and think it would be constructed along the following lines:

A small FM receiver would be set up to detect a tone such as that from the CRICKET with the output driving a relay.

It would be very useful in the security field to operate remote devices and I have not found anything on the commercial market along these lines.

I hope you can see your way to doing some of these things, and look forward to the next issue of the magazine.

T.C. 6019.

The next letter takes a different tack:

Congratulations on the content of the magazine. I do not like to criticize but I was disappointed when your policy of low advertising material was broken in the "FM Bugs" issue. It contained over 50% advertising. I would like to see this kept to a minimum.

I would also like to suggest that more reader contributions be published. Perhaps a page of readers circuits in each issue and keep out the "power supply" and "headlight reminder." Surely people only need to install one of these in their car!

I enjoy reading your magazine and only wish it came out more often.

There is however, one point on which we disagree.

A CRO is a very useful piece of test equipment for fault-finding electronic circuits, provided it is in capable hands.

You seem to portray the oscilloscope as a useless piece of junk that has no purpose whatsoever. Many times a CRO has come to the rescue in digital circuits and other projects I have built, allowing them to work and not reside in the bottom of the junk box.

Perhaps if you were to include some waveforms of the TEC and other projects it may help readers to learn more about fault-finding.

In conclusion, I think you should give the CRO a fair go. At least publish a list of pro's and con's so that readers can decide for themselves.

What I am trying to do is put the CRO in perspective as far as the hobbyist is concerned.

At the moment most hobbyists have the same misunderstanding that I had, some 15 years ago. I thought the CRO would be the answer to my problems and it would solve everything.

My introduction to the CRO came soon after I started TV servicing. I had a particularly stubborn B&W set and spent days trying to solve the problem.

It was a Thorn Atlas with very weak vertical lock. The picture would roll down and the vert hold control didn't stop it.

I had practically re-built the vertical section and the fault still persisted.

The CRO was my last resort and I decided to buy one.

I bought a BWD 10MHz model and was the latest at the time.

Although I was not expert with it on my first job, I tried for hours to locate the fault.

All the waveforms seemed perfect and corresponded exactly to the diagrams given on the circuit diagram.

Feeling a sense of disappointment, to say the least, I put the CRO away and left the set for a week without even thinking about it.

When I came back to it, I started on a different tack and began to test all the electrolytics in the power supply and its branches.

All of a sudden it came good. The fault was a filter electro on one of the minor power rails. The 100Hz mains hum was getting into the vertical section and negating the sync pulse.

Don't think I have an aversion to the CRO. It is the most valuable piece of test equipment ever invented.

But let me say that over a period of 15 years repairing B&W and Colour sets, I would have used the CRO only a dozen times or so. My boss serviced TV's for 25 years and didn't even own a CRO!

When designing our projects, the CRO is only used in the final stages of design. It's used to take readings of amplitude, frequency or waveform to make sure they correspond to that expected.

If you think a CRO will solve all your problems, you are mistaken. It takes a lot of interpreting the waveform on the screen to decide if something is amiss. You need to know which parts of the waveform will be creating the problem and which parts are the result of the problem. You also need to know how much effect the CRO is contributing as it will introduce a considerable amount of hum on some stages.

Yes, there are a lot of pro's and con's and that's why we have presented TE in the way it is. We consider we have tackled fault-finding of each project in the best way and would like to know of any better way.

On the point of fixing the TEC with a CRO, we have never used a CRO for this job. It would be just too confusing and too slow.

The LOGIC PROBE is the only piece of test equipment for this including the CONTINUITY TESTER to make the thousands of tests between the tracks.

For FM bugs, you would need a 100MHz CRO to test the oscillator section and a simple audio amplifier is sufficient to test the audio stages.

So a CRO is not needed for this either.

Next we have NZ reader:

I recently ordered 2 Voyager kits. It was the fastest mail order I have ever received.

I was pleased to see the batteries were included and it worked first time. I look forward to further development of SM devices but they are very fiddley to solder.

Being an enthusiastic amateur, I seek your assistance. On P 7 of BUGGING, you use a simple Power Meter as described in More FM Bugs. I can't find the circuit, unless you mean the Peaking Circuit, on P 24 of More FM Bugs.

I would like to increase the range of the Voyager but have come to an impasse. Last night I detected the Voyager at 500m and the reception was quite clear, but only in spots and these would reappear at 30m intervals. I would like to increase the range to 1km.

Another note. On page 66 of BUGGING, you refer to a ghost bug i.e. transparent to a car radio. Incorrect. I used my car radio to locate and measure the Voyagers range.

The radio was a National PLL Synthesised Tuner with digital frequency readout. The Voyager was operating on 94.85MHz.

THE CRO IS A WONDERFUL SERVICING AID BUT IT NEEDS A LOT OF SKILL TO INTERPRET.

Of course Surface Mount parts are fiddley. They are not meant to be handled at all. Surface mount capacitors are even smaller and beyond hand soldering, so think yourself lucky.

The Power Meter we refer to is that described on P66 of Bugging. The "Peaking Circuit" or "Bug Tuner" is described on P 24 of More FM Bugs.

Taking the Voyager up to 12v may get you the range you want but the best move is to make the Ultima, described in this issue.

The ghost bug we are referring to is not detected on CHEAP DIGITAL RADIOS. These jump in steps of 100kHz and if the bug is transmitting on 94.85 it will not be picked up as the bandwidth of the bug is only about 20-30kHz.

Next a letter from J.H. of 6110.

My commendations to all on the contents of the magazines.

May I make a few suggestions for your consideration.

Firstly, I thoroughly agree with you re the decent-sized clear, complete schematics at the start of each project. It makes life much easier.

You could make it slightly better by including voltage points and current readings on the schematic. Maybe you could make a separate book on troubleshooting the FM bugs and general electronics. It certainly would be popular.

Another suggestion is to make a workable directional antenna. This will allow normal radios to be turned into RDF sets.

I think the voltage points are a very good idea and hope to include them in some of the projects in this issue and those that follow.

During my days of TV servicing I liked the diagrams that included voltage points as it gave some idea of what to expect.

Most of our projects include a section on HOW IT WORKS and Troubleshooting in which we give many of the voltage readings and you can label the diagrams yourself.

For the RDF antenna, I hope we can present this next issue. It's a great idea.

L.N. of 4013 writes:

I have followed your bug books from the beginning and read about the development of the Infinity Bug.

I would like to know if it has been presented as a kit or if you intend to do so.

Not at this stage. It has taken a lot development and cost us many thousands of dollars.

Our latest model silences both mechanical and electronic phones and sells for just $330. See the back pages for more details.

Our final discussion came via the phone.

The caller bought two Voyagers - one worked very well but the other was not very good. What should he do?

This first thing I suggested was to change the RF transistor.

Since much of the range depends on the gain of this transistor when operating at 100MHz, it would be the first component to suspect.

The fact that a simple transistor like the BC 547 operates at such a high frequency is really amazing.

Even the 2N 3563 doesn't work as well as the BC 547 in the Voyager so keep to the type we suggest.

The only other possibility is a wrong value resistor on the base or emitter.

Generally if you damage a surface mount resistor it goes open and the circuit doesn't work at all - they don't "change value" or "go high."

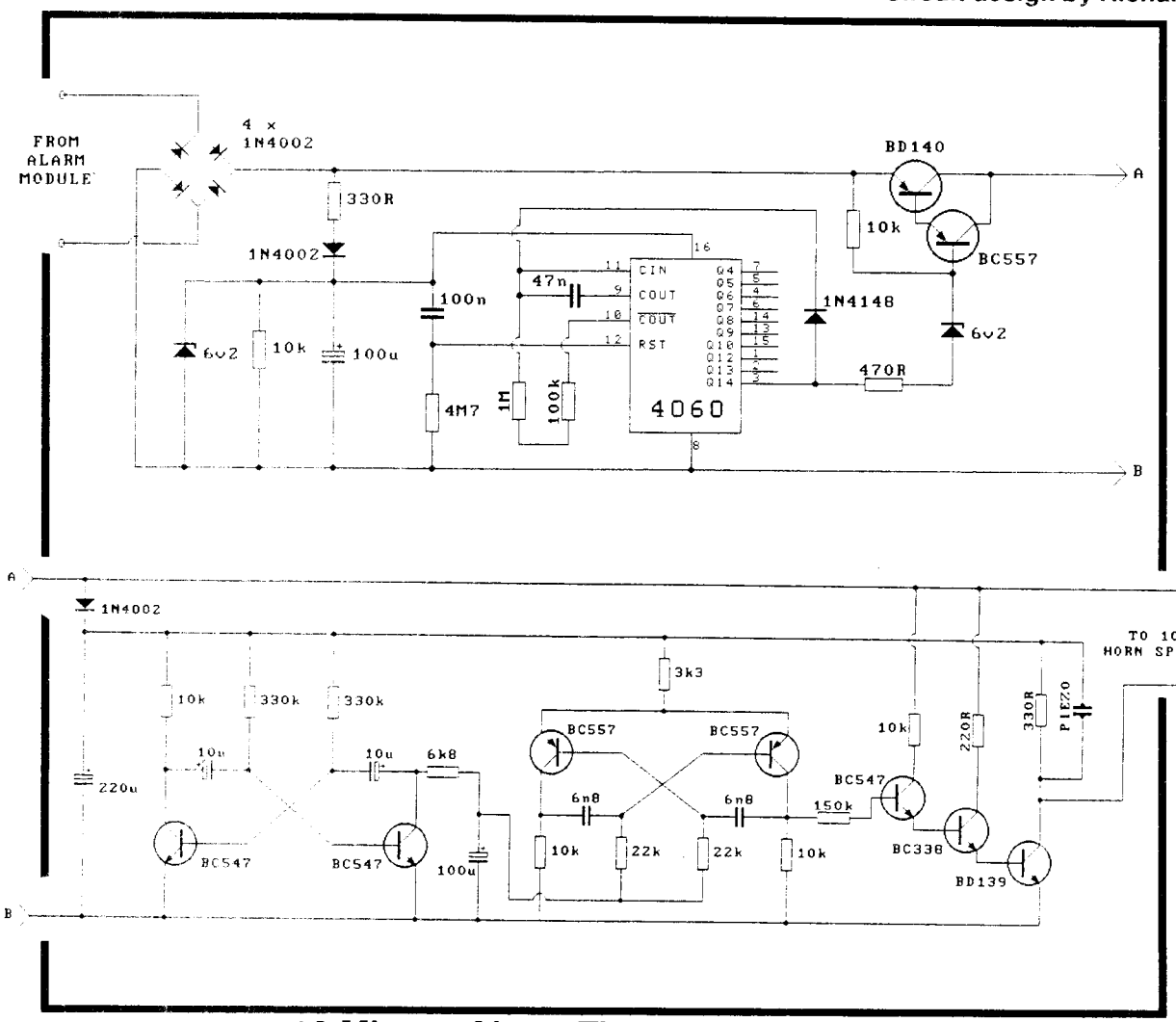
You can also try the capacitors but my suggestion is to start again with a new kit as you will have effectively rebuilt the circuit anyway and the board will be really messy!

10 Minute Alarm Timer

Parts $13.30
PC board $3.50
Total: $16.80

Converts old style alarms into 10 minute alarms

Circuit design by Richard Borg



10 Minute Alarm Timer circuit

How many times have you had the silence of a calm night interrupted by the wail of a burglar alarm?

What's the first thing that comes to mind?

"Another faulty ------ alarm!"

A few years ago the alarm at our our local self service went off at 2 o'clock in the morning.

I was still working on an article and for an hour I put up with the background wailing - hoping the thing would run out of steam.

Eventually I couldn't take it any more so I put on my dust coat and loaded my long ladder into the car to pay the alarm a visit.

At the shop the sound was deafening and I was surprised the nearby neighbours had not done something about it.

I parked the car, left the headlights on full beam and gathered a screwdriver, pair of cutters and the ladder.

I had just got on the verandah when - you guessed it - the police came screaming down the road. A casual wave from a dust coated "serviceman" and the police didn't even stop to investigate!

A quick unscrew of the metal box and "snip." Dead silence, apart from the ringing in my ears.

The alarm never annoyed us again.

But this needn't happen.

With our 10 Minute Alarm Timer project you can convert any of the old style alarms into the mandatory 10 minute alarm.

Many councils have introduced a by-law limiting the operation of a wailing device to 10 minutes or less.

Our circuit can be added to any alarm output to give this time limit. It also has an inbuilt wailing circuit so that an ordinary horn speaker can be used on the output.

This will update some of the old style tones to the modern wailing type.

In fact this project can be used as a stand-alone unit and needs only a grasshopper switch and battery for its operation.

A grasshopper is a spring loaded switch that is kept apart by an insulator such as a strip of plastic between the contacts. When the strip is pulled out of the switch, it closes. If you have a battery such as a 12v gell cell you have the

makings of a powerful alarm, enough to wake the neighbours for miles around.

Another incidence occurred with our next door neighbour's alarm. At 9.30am it went off. By 11.30 I had had enough and was on the roof taking off tiles and looking for the wiring to the horn speaker. A pair of side cutters is a powerful tool. Another alarm that doesn't bother us any more.

This is how I feel about alarms, but you may feel differently. The general consensus confirms that alarms have lost their impact.

A recent TV program proved this. A car alarm was set off in a busy car park and for 20 minutes one of the film crew fiddled about trying to stop the noise. Not once was he challenged by those using the parking area.

But if you have faith in alarms, here's the add-on that will bring your system up to date.

It is very simple to build and requires nothing more than cutting the wire to the siren and inserting the board.

This can be done anywhere along the wiring but if it placed near the alarm module, a piezo on the board will act as a monitor and you can hear what's happening.

HOW THE CIRCUIT WORKS

The circuit draws its power from the alarm to which it is connected.

Most alarms have 2 outputs - a DC output and siren output. This allows either a siren or horn speaker to be connected.

You can find out which connection is available on your system by adding an ordinary speaker to the output and turning the alarm on.

If a wailing sound is produced, the output is "SIREN."

If nothing is heard, the output will be "DC."

If this is the case, you can add our 10 Minute Alarm Timer project.

The board needs only 4 wires. Two for the input (for the positive and negative) and two for the output to the horn speaker or siren.

On the input we have provided a full wave bridge so that the board can be connected to the alarm either way around. The bridge drops 1.2v and reduces the output of the horn speaker very slightly.

If you know the polarity of the output of the alarm, this bridge can be omitted and the wires connected directly to the positive and negative of the circuit.

When the output of the alarm is activated, voltage appears on the rails of the timing chip (CD 4060) and it gets reset by the 100n and 4M7 on pin 12.

When this reset pulse decays (after about 1/2 sec), the chip will count via the oscillator made up of the timing components: 47n, 1M and 100k trimmer.

The chip has an internal clock and only requires a resistor and capacitor to set the frequency. The 4060 is a 14 stage divider and pin 3 will go high after 8192 counts. A high on this pin will freeze the counting and turn off the super-alpha pass arrangement made up of a BC 557 and BD 140.

These transistors are turned on when pin 3 is low and a current of about 1 amp is allowed to pass to the wailing circuit and horn speaker.

When pin 3 goes high the pass transistor is turned off by the 10k resistor (between base and emitter).

The timing chip has its own regulated supply made up of the 6v2 zener and 100uF electrolytic.

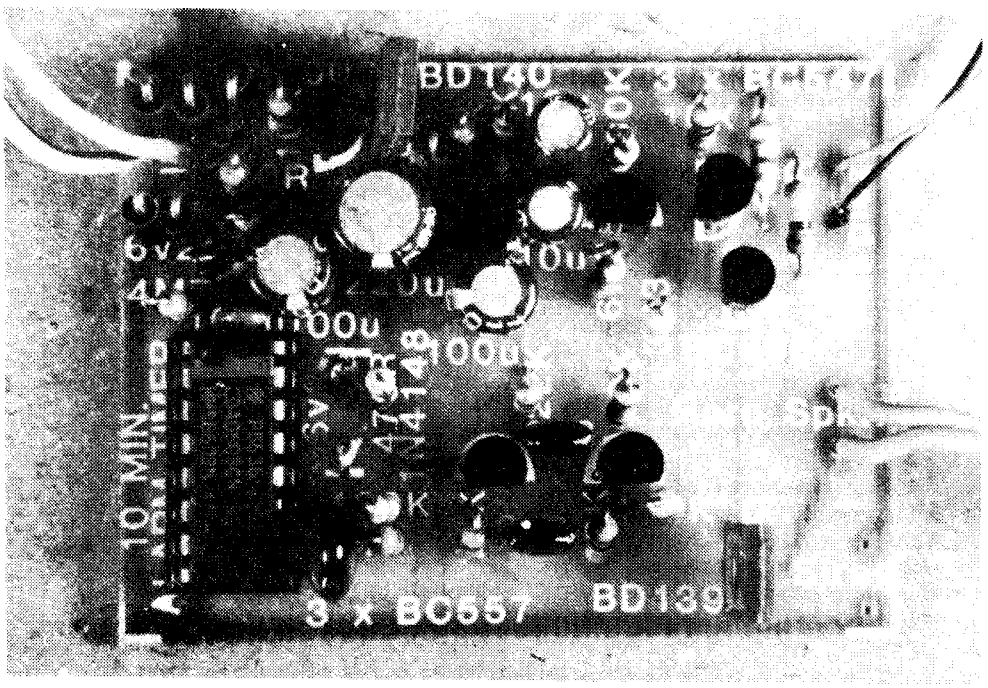
The 6v2 zener on the output makes sure the pass transistor is fully turned off at the end of 10 minutes.

The wailing tone is produced by the combination of two multivibrators. One is a low frequency oscillator with a cycle time of about 2 seconds and the other is a voltage controlled oscillator with a mid frequency of about 3kHz and is controlled by the first oscillator.

The first oscillator is made up of two BC 547 transistors and is a square wave with a mark/space ratio of 50%.

Its output charges a 100uF electrolytic via two 22k resistors from the second oscillator.

This voltage is used to set the frequency of the second oscillator and as the voltage is reduced, the output frequency increases. When the voltage increases, the tone decreases.



PARTS LIST

1 - 220R
2 - 330R
1 - 470R
1 - 3k3
1 - 6k8
6 - 10k
2 - 22k
1 - 100k
1 - 150k
2 - 330k
1 - 1M
1 - 4M7

2 - 6n8 greencap
1 - 47n greencap
1 - 100n monoblock

2 - 10u 16v electrolytic
2 - 100u 16v
1 - 220u 16v

1 - 1N 4148 signal diode
6 - 1N 4002 power diodes
2 - 6v2 400mW zeners
3 - BC 547 transistors
3 - BC 557 transistors
1 - BC 338 transistor
1 - BD 139 transistor
1 - BD 140 transistor
1 - CD 4060 IC
1 - mini piezo
1 - 16 pin IC socket

1 - 10 Min Alarm Timer PC board

This frequency is passed to a very high gain circuit made up of a BC 547, BC 338 and BD 139 and the output consists of a constantly rising and falling tone.

The output puts very little load on the oscillator stage, via a 150k, so that the tone of the siren is not affected.

The horn speaker is placed in the collector of the output transistor and a piezo in the same line monitors the output.

TESTING AND IF IT DOESN'T WORK

Test the circuit by connecting it to a 12v gell cell and add a speaker or siren to the output.

If the circuit works, it will deafen you so disconnect the speaker and monitor it via the piezo. It should operate for 10 minutes then stop.

If this does not happen, the circuit should be investigated in a logical manner.

This is where most of our constructors fall down. They don't know where to start.

Hopefully your project will not work. Yes. That's right. Will not work. Only then will you start to learn how to read a diagram and fix a fault.

If you are going to use a gell cell as the supply, fit a 15R - 47R 1/4watt resistor in one line to act as a fuse, if a short occurs in the circuit, the resistor will burn out.

Firstly measure the voltage at the output of the bridge and at the "siren" terminals. It should be about 11v in both cases (or 10v when 22R "fuse" is added).

If the output of the bridge is zero, one or more of the diodes will be faulty, not connecting or around the wrong way.

If the "safety resistor" blows, a short is present (the speaker should not be fitted for this part of the test).

Remove the BD 140 and fit a new fuse. If it still blows, the short will be in the diode bridge. Replace all 4 diodes.

If the rail voltage is low at the output of the pass transistor (BD 140) the transistor will not be turned on.

Place a 1k resistor between the base of the BC 557 and ground. This will turn on the supply to the tone circuit. If not, either the BC 557 or BD 140 is faulty.

Next place a 100R between the anode of the 6v2 and ground. This will also turn on the supply, otherwise the 6v2 is faulty.

Measure the voltage on pin 3 of the CD 4060. It should be low (about .7v). If not, the earth line to the chip may be missing or the chip may not be reset. Take pin 12 HIGH momentarily and measure pin 3 again.

Make sure pin 16 has approx 6v on it and if none of these make pin 3 low, replace the chip.

If the piezo never turns off, the CD 4060 may not be clocking. You can check this by measuring pin 7, 5 or 4 with a multimeter. Pin 7 will produce a square wave of a reasonably high rate, pin 5 will give a lower frequency and pin 4 will be lower again.

While dealing with this stage, there is one further test you should make.

When everything is working correctly you should turn the circuit on and leave it operating for about an hour or so.

The piezo should sound for 10 minutes and not come on again.

If it starts to wail again after 20 minutes, the "freeze" circuit is not operating. This is the diode between pin 3 and 11. It puts a low on the oscillator after 10 minutes to turn off the clock.

Make sure this is operating before using the project, otherwise the alarm will turn on and off every 20 minutes!

Next we come to the siren circuit made up of the two multivibrators.

To test these, fit the piezo between the collector of either BC 557 and ground.

You should hear a faint siren sound. This means the buffer arrangement, made up of the BC 547, BC 338 and BD 139 is not working.

Next connect the piezo across the 10k load resistor of the BC 547. A tone here will indicate the 338 and 139 are not functioning and no tone will mean the BC 547 is faulty.

Take the emitter of the BC 547 to ground and listen again. If no tone, replace the transistor and/or the 150k separating resistor.

Repeat with the BC 338 and you will be able to narrow the field to the exact component.

If no tone is produced from the siren circuit you should firstly measure the voltage on the 100uF electrolytic. You will be able to detect the voltage rising and falling.

If no movement is detected, measure the voltage on the collector of either BC 547 in the low frequency stage. If it does not go high-low-high-low, the multivibrator is not functioning.

This will result in a constant tone from the piezo (when it is connected to the PC board as indicated on the overlay).

Check the voltage on the 220uF to make sure it is approx 10v (8v with 22R fitted).

Take the positive of the 100uF to the supply rail of the circuit (the positive of the 220u) and measure the voltage on the collector of either BC 547 to see the multivibrator operating.

This means the fault lies in the collector of the second BC 547 not getting sufficient voltage to charge the 10u electrolytic.

Take either 22k to the positive rail to provide this turn-on voltage and measure the output of the first multivibrator with a voltmeter.

Check the voltage on the emitter of either BC 557 to make sure the supply voltage is getting through via the 3k3 supply resistor, and base-emitter junction of the BC 557's and 22k's. Once the low frequency multivibrator is operating, go to the high frequency multivibrator.

Shorting the 100u will create a constant high tone on the output and if this does not occur, measure the 10k collector resistor to make sure a voltage is present and is equal for both.

This is about as far as we can go with simple tests. Anything further will require a CRO to look at the waveforms.

But most of the time the fault will be the result of poor soldering such as bridges, dry joints or the wrong value component.

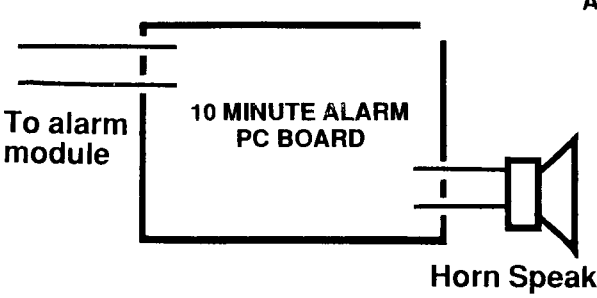
You should get someone else to check your project before thinking it is something more serious.

FITTING

Fitting the board couldn't be easier. Simply cut the DC wires to the siren and insert the PC board. The "IN" line is marked on the board and the output can be either a horn speaker or siren. Refer to the diagram below for the connections.

That's all there is to it.

Artwork on P. 54 . . .



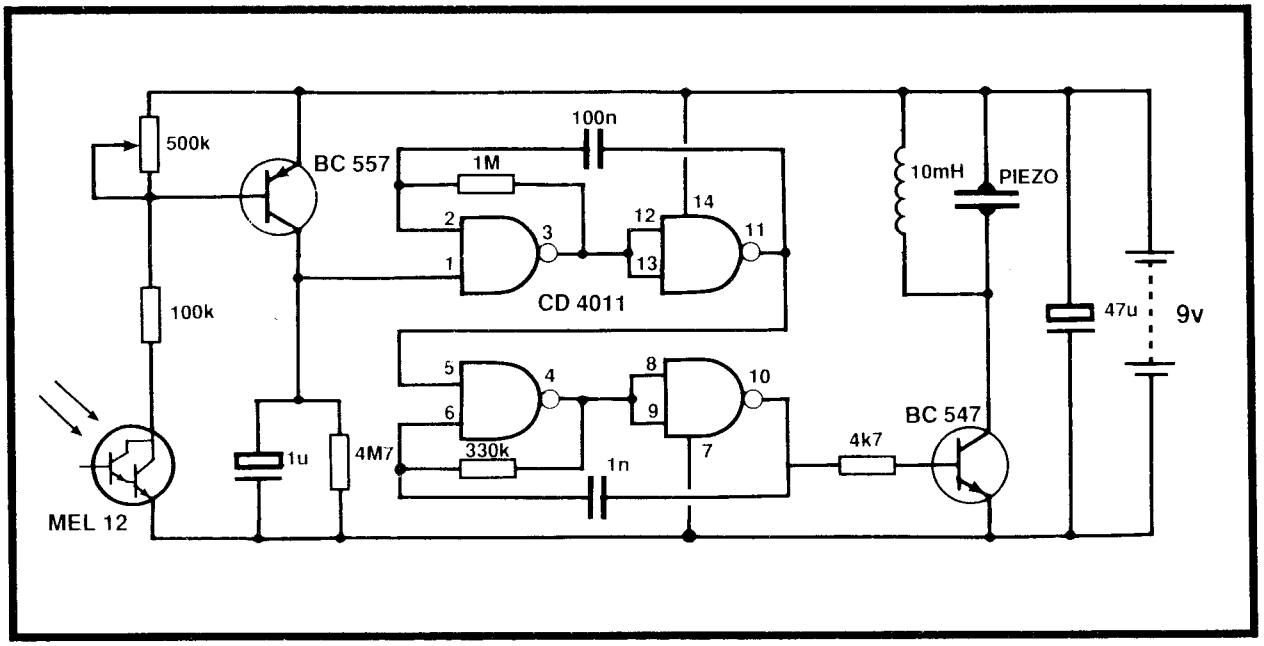
Wiring the 10 min Alarm Timer board

LIGHT ALARM

DETECTS THE SLIGHTEST LIGHT

Parts $9.00
PC board $2.50
Total $11.50

Circuit design by Richard Borg



LIGHT ALARM CIRCUIT

Protect your medicine chest, lolly cupboard or cash drawer with this LIGHT ALARM.

Hide it in a dark place and the circuit sits ready for activation.

The current consumption is practically zero in the dark state and the battery life will be its normal shelf life.

When light falls on the photo darlington transistor, its resistance decreases and sets off the alarm.

A delay is built into the circuit to keep the alarm sounding, even though the culprit may close the drawer or cupboard as soon as he hears the alarm.

The circuit is very sensitive and will be triggered by the slightest amount of light.

A normal fridge alarm has the light of the fridge to set it off but this unit will be suitable for even the darkest of conditions.

HOW THE CIRCUIT WORKS

When light does not fall on the light-sensitive darlington photo- transistor, its resistance is almost infinite.

This means no current flows through the 500k pot and 100k resistor and no voltage drop appears across them.

The result is the PNP transistor is not turned ON and so the input (pin 1) of the first gate is LOW (zero).

The first two gates form a "gated oscillator" and when the gating line is low, the oscillator is inhibited.

When light falls on the photo transistor, its resistance decreases and current flows through the 500k pot and 100k resistor. A voltage drop appears across the 500k pot and this turns the PNP transistor ON.

The input line of the gated oscillator goes HIGH and the oscillator produces a frequency that turns the main oscillator ON and OFF.

The 1u electrolytic charges when the BC 557 conducts and together with the 4M7 they form a "delay circuit" that will be covered later.

When the output of the low frequency oscillator is HIGH, it turns on the second oscillator and this produces a high frequency that is coupled to the piezo via a buffer transistor.

Across the piezo is a "ringing choke" and the two components form a resonant circuit with the piezo being the capacitive part of the circuit (20n - 30n) and the choke being the inductive part (10mH).

When energy is supplied to this arrangement, it is firstly stored in the piezo. The transistor turns off and the piezo discharges into the choke. When it can no longer deliver energy to the choke, the

PARTS LIST

1 - 4k7
1 - 100k
1 - 330k
1 - 1M
1 - 4M7

1 - 500k mini trim pot

1 - 1n 100v
1 - 100n 100v

1 - 1u 16v PC mount electrolytic
1 - 47u PC mount electrolytic

1 - BC 547 transistor
1 - BC 557 transistor
1 - MEL 12 photo darlington transistor

1 - 4011 IC
1 - 10mH choke (or parts to wind your own)
1 - piezo diaphragm
1 - 14 pin IC socket
1 - 9v battery snap
1 - 9v battery

1 - LIGHT ALARM PC BOARD

current is reversed and the choke begins to deliver energy to the piezo.

This occurs very fast as the magnetic field of the choke collapses very quickly and the voltage it can supply will be much higher than rail voltage (about 60v - 90v).

This is why the output of the piezo is so loud when the choke is connected across it.

This oscillatory effect can go back and forth a few times before the transistor turns on again and creates a ringing effect.

When light is removed from the photo transistor, the delay circuit takes over and the tone is emitted from the circuit for a further 5 seconds of so.

The delay circuit consists of a 1u and 4M7 on the input line of the first NAND gate and when the voltage falls below about 30% of rail voltage, the oscillator turns off.

The actual operation of the gated oscillator is quite complex and contains a few hidden secrets that need careful explaining.

When the gating line goes HIGH, the gate is allowed to go into its inverting mode.

If a resistor is connected between the output and input, the gate will operate at an extremely high frequency. In other words it will oscillate.

In our circuit, the capacitor prevents the input from rising quickly and, as you will see later, controls the rate of oscillation (together with the resistor).

If you have followed the discussion so far, you are half-way through.

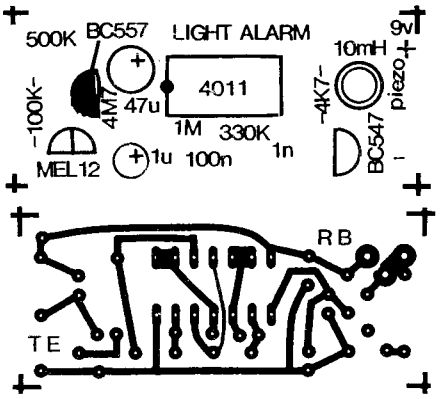
To describe the action of the capacitor we will have to start from the beginning again.

The action of the capacitor is more complex than first meets the eye.

When the circuit is at rest, the gating line is low and the output will be high.

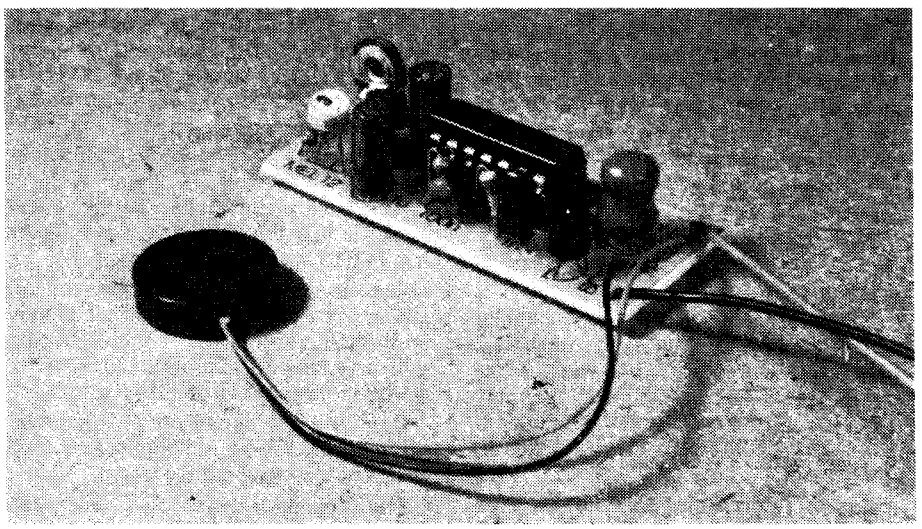
See "Digital Electronics Revealed" P 17 for the four states of a NAND gate.

The 1M transfers the HIGH to the other input line and this end of the 100n capacitor sees a HIGH.

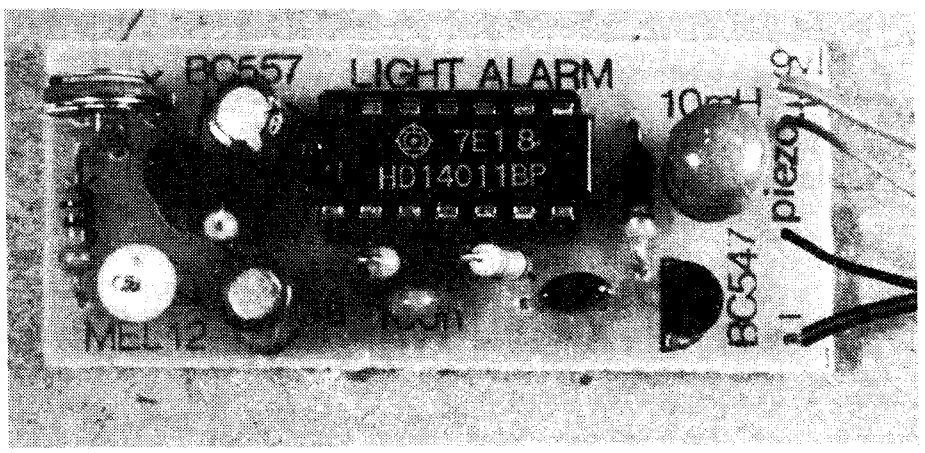


The artwork for the Light Alarm is very easy to reproduce yourself. All you need is a Dalo pen and etching chemicals. There is one fine track between the IC lands where care is needed.

Note: the loudness of the piezo depends on the value of the choke. It is the collapsing of the magnetic field of the choke that produces the high voltage that makes the piezo sound loud.



All PC boards come with a clear overlay so you know exactly where every component goes. The photo below proves this.



The output of the second gate is low and thus the end of the capacitor connected to this end sees a LOW.

This means the capacitor is charged to 9v.

When the gating line goes HIGH, the output of the first gate goes LOW and the output of the second gates goes HIGH.

This "jacks up" the capacitor and makes the positive end go higher than the positive rail.

But a set of diodes on the input line of the first gate prevents the voltage going higher than rail voltage and quickly discharges the capacitor.

The capacitor is now uncharged and begins to charge in the opposite direction via the 1M resistor. As it charges, the voltage on pin 2 falls and when it reaches 30% of rail voltage, the gate changes state. See Electronics Notebook 4 P32 for a fuller description.

The frequency of operation is determined by the 100n and 1M. When the output is HIGH, the second oscillator is switched ON and will operate in exactly the same mode but this time the frequency of operation will be considerably higher as the component values are lower.

THE CHOKE

Some kits will include the components for the 10mH choke and you will be able to make your own.

This will give you valuable experience in coil winding and will help you understand how many turns are required to create the inductance.

Use the wire supplied and start winding by leaving 1cm of wire over-hanging the bobbin. The number of turns to wind on the bobbin is contained in the choke kit and end the winding by leaving 1cm over-hanging the same end. Use a small amount of glue such as "Tarzan's Grip" to keep the turns in place or fit heatshrink and shrink it down with a candle.

Carefully tin the ends of the wire with a soldering iron and the choke is ready for fitting.

CONSTRUCTION

All the components mount on the PC board and the overlay indicates the position of each part.

Firstly fit the IC socket so that the notch, or cut-out (at the end) matches the identification dot on the board.

This will let you identify pin 1 on the chip (pin 1 is next to the cut-out on the end of the IC), and prevents it being fitted around the wrong way.

The rest of the components are fitted one at a time. Start at one end of the board and work across methodically, fitting each part as you come to it.

Push them against the board so that they are as low as possible and hold them with your finger so that they don't move or get too hot when soldering.

This is the best way to make sure you don't overheat anything, especially the transistor, electrolytics or photo transistor, as they can be damaged slightly if they get too hot.

The leads of the piezo and battery snap are connected and the IC fitted. The board is now ready for testing.

TESTING

Make sure everything has been fitted to the board, including the IC and you should go over the layout one more time to make sure nothing has been placed in the wrong location.

Turn the 500k mini trim pot to mid position and connect the battery.

You should hear a beep-beep-beep from the piezo. Place the whole circuit in a drawer and shut the drawer. After about 5 seconds the beeping will cease. Open the drawer slightly and the alarm will sound.

To make the circuit more sensitive, turn the pot so that the wiper moves away from the positive rail. To make it less sensitive, move the wiper towards the positive rail.

To increase the delay time, change the 1u to 2u2, 4u7 or 10u etc.

To make the beep tone higher, decrease the 330k to 220k. To lower the tone, increase it to 470k.

To slow down the beep-beep-beep, increase the 1M to 2M2. To speed up the beep-beep-beep, reduce the 1M to 470k.

Go through the IF IT DOESN'T WORK section to make sure the circuit is drawing the correct current and the project is ready for fitting into a box or onto a sheet of plastic. Use double sided foam tape to keep the board, piezo and battery in position.

IF IT DOESN'T WORK

If the circuit doesn't work you should check the soldering, especially around the IC. Make sure all the parts are fitted in their correct positions. Make sure the IC is around the correct way and 9v is on the power rails by measuring with a multimeter.

Check the current consumption. It should be between zero (for dark conditions) and 30mA for alarm conditions. Anything higher than 50mA will indicate a fault such as a short, faulty chip or high leakage through the output transistor etc.

If no sound comes from the piezo, you will have to test the buffer (driver) transistor.

Remove the chip and measure the circuit current. It should be zero.

If not, a leak is present across the driver transistor. If the leakage current is around 10mA or so, the fault is most likely to be the driver transistor. If the current is very low, it will be the front end detecting light and all is ok.

To test the driver transistor, take the 4k7 to the positive rail via a jumper lead. The current should increase to to 100mA or so. This indicates the transistor is operating.

If the current is over 300mA, the choke may be the wrong value. To test this, replace it with a 330R and replace the chip. The circuit should work but only very faintly. If a tone is not heard, keep the 330R in circuit and proceed with more tests.

It is very difficult to make DC tests on the gated oscillators as you cannot take any of the lines high or low without fear of damaging the outputs of the chip.

The only way you can get around this is to put a 100R on jumper leads and call it a "SAFETY JUMPER." When this safety jumper is used on any of the lines you can force the line either high or low without damaging the driver transistors inside the chip.

Turn the circuit ON and take pin 5 high. This should produce a continuous tone from the piezo.

If not, the tone circuit is faulty (this could be the chip, the 330R, or the 1n capacitor).

Replace all three and the tone should come on. If not, the only other possibility will be fault trackwork on the underside of the PC board. Check around the oscillator and the 4k7 resistor.

If the tone is very weak with either the choke or resistor fitted, the choke may be the wrong value or you may have wound it incorrectly.

If you kink the wire when winding, the enamel may come off and if this spot touches another similarly damaged spot, a shorted-turn will result and the choke will not produce the over-voltage.

If you have a CRO, the waveform can be checked and it should be 30v-90v.

If the output is still very weak, one of the wires connecting to the diaphragm may have come off or the insulating layer between the contacts may have "punctured."

If only a continuous tone is heard, the fault will lie in the low-frequency oscillator. The most likely cause is one or both gates of the chip being damaged or the 1M or 100n components.

Check the underside of the board for shorts and look for any connections that have been forgotten.

The final sections to test are the light-sensing section and delay circuit.

If the circuit does not continue to beep when the drawer or cupboard has been closed, the 1u electrolytic will be open circuit or not connected correctly. Replace with another and make sure the positive and negative leads are taken to the correct holes.

If the front end is not very sensitive, the fault will lie in the photo transistor and/or the PNP transistor.

You can check the sensitivity of the photo transistor by connecting it directly to the input line of the first NAND gate with only the 4M7 to ground. All the other components should be removed.

Compare the sensitivity in this mode with the circuit as published and note they should be about the same.

The reason for this is the 1u alters the sensitivity and the PNP amplifier is required to restore the gain.

If the circuit doesn't turn off, the photo transistor may be leaky, (or it may be detecting low-level light), the PNP transistor may be leaky or a leak may exist on the board.

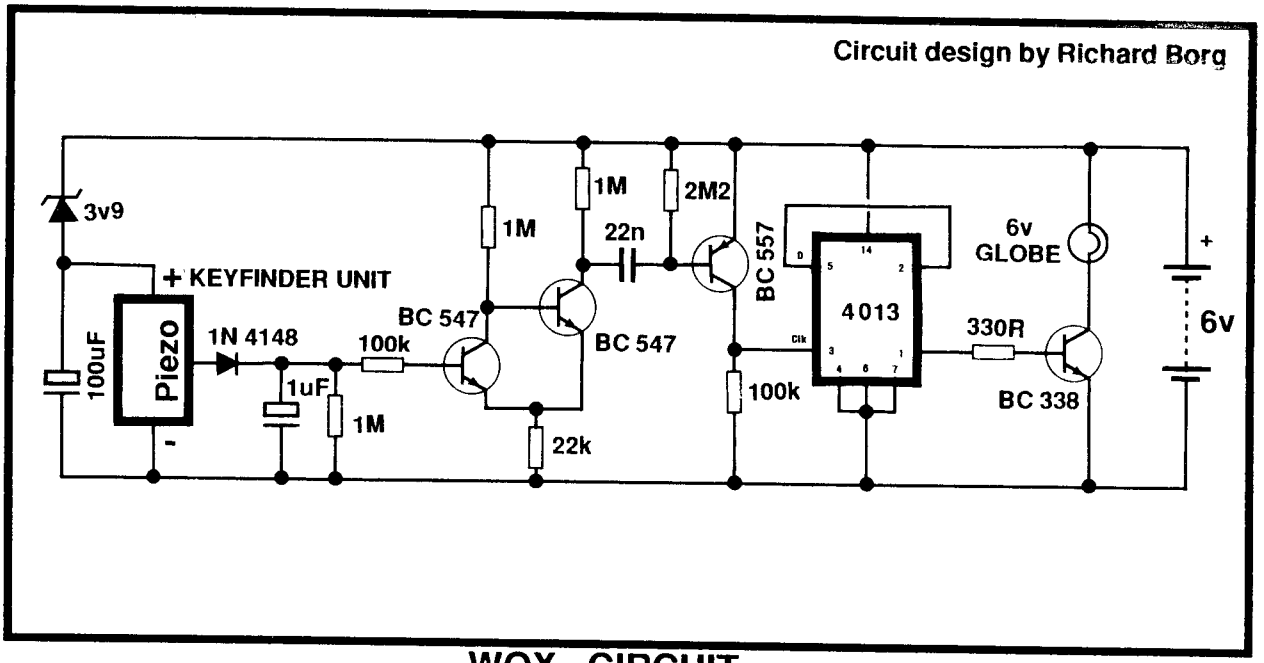
Try adjusting the 500k mini trim pot. When the wiper is taken to the positive rail, the circuit should turn off. If not, the transistor is faulty.

Adjust the sensitivity to suit your conditions and allow the circuit to switch on. Reduce the light level and the circuit will turn off after about 5 seconds. We have now covered the whole circuit and everything should be working perfectly. I hope you put it to good use.

THE WOX

Whistle-ON Whistle-OFF Switch

Parts $5.00
PC board $2.50
Total $7.50
Keyfinder $3.50 extra



WOX CIRCUIT

All our projects need a name to make them easy to describe in the magazine. So we had to think of a name for this project. If a voice operated switch is a VOX, then a whistle operated switch is a WOX!

This great name came like a flash, from our inventive member of staff, David, when asked for a few suggestions.

The WOX is a new concept in presenting a project. It uses a readily-available chip from a keyfinder as the heart of the of the project and combines it with additional circuitry to operate a globe.

Nearly everyone must have an old keyfinder lying around the home. The button cells are so expensive to replace that they become a throw-away item when the batteries go flat. Initially they sold for about $15 and as the market gradually saturated, the price fell to $10, $5 and are now about $3!

The market is fully saturated and every junk shop is throwing them out as an impulse line.

At a casual glance, the keyfinder concept appears as a clever device that doesn't warrant any further attention. But on closer inspection we have noted it has gone through 3 generations of improvements and a lot of designing has been involved.

Initially the circuit used an 8 pin chip and needed the support of 4 or more external components to set the tone of the beep.

In the second generation, the chip was replaced by a surface-mounted substrate hiding under a dob of black acrylic and required 2 external components.

In the 3rd generation, the components have been done away with and the chip is programmed to beep 3 times when a whistle of the correct tone is detected.

But the beeping has an interesting side issue.

The latest model keyfinder beeps once if activated during the first minute or so after the two cells have been fitted, and then three times during the rest of its life.

This means a counting circuit must be clocked via the oscillator before the 3-repeat function is activated.

PARTS LIST

1 - 330R
1 - 22k
2 - 100k
3 - 1M
1 - 2M2
1 - 22n ceramic
1 - 1uF PC electrolytic
1 - 100uF PC mount electrolytic

1 - 3v9 zener diode
1 - 1N 4148 diode
2 - BC 547 transistors
1 - BC 557 transistor
1 - BC 338 transistor
1 - CD 4013 dual flip flop
1 - 14 pin IC socket
1 - 6v lantern battery (not in kit)
1 - 6v globe
1 - 5cm tinned copper wire
3 - 10cm hookup wire

1 - keyfinder ($3.50 extra)

1 - WOX PC board

This is quite an interesting discovery and it means the chip contains a long dividing chain - something you would never think was present.

Overall, the chip is an amazing piece of electronics and contains a frequency sensitive circuit to allow only a very narrow frequency to be accepted. It also uses one piezo diaphragm for both the detection and production of the tone. All this, with a current consumption of about 20uA!

The best part of our design is the use of a possibly-discarded product and turning it into a useful piece of equipment.

We could not do better with discrete components nor match the price, so we have to accept defeat.

We have found only one other whistle-operated product on the market and it consumed over 200 times the current of the WOX so you can see ours is streets ahead of anything else.

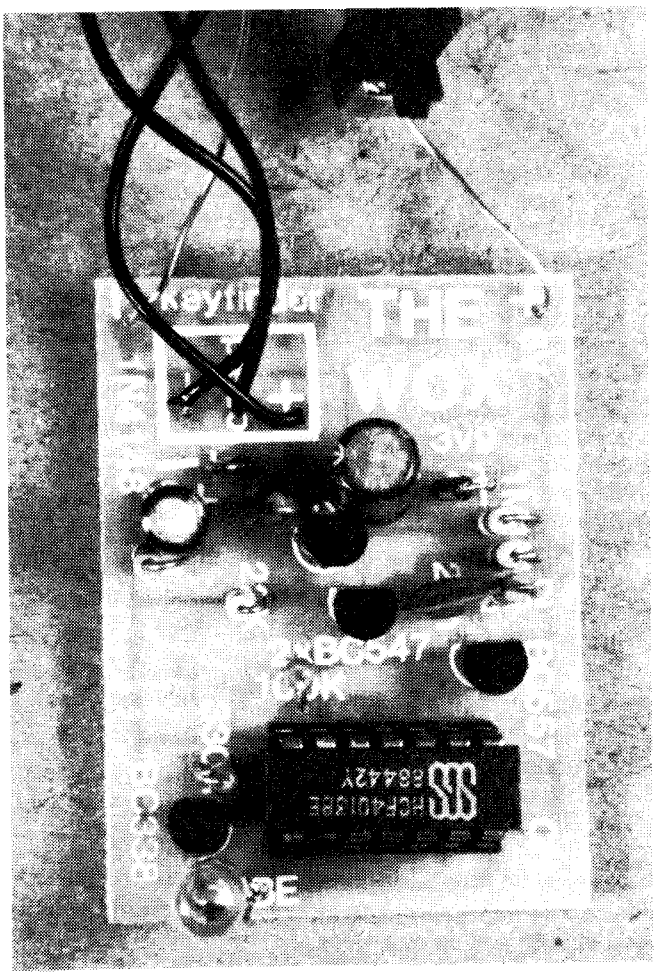
Our design consumes about 30uA and will allow a 6v lantern battery to last almost its shelf life.

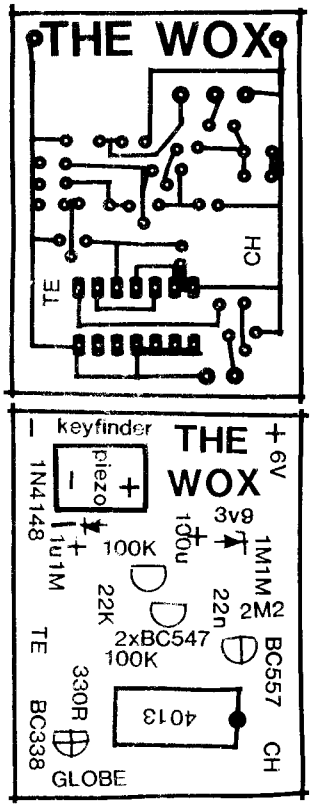
Although this project does not strictly fall into the security category, it can be used in the home or workshop (toilet or shed etc), where a light switch has been placed in an awkward location or where there is a long corridor and only one switch.

The only problem I can see is for those who cannot whistle. If that's the case, you should start practicing.

HOW THE CIRCUIT WORKS

The project uses a keyfinder for the front end and to supply 3v to the chip, a zener diode has been used.





A 100uF electrolytic across the keyfinder section stabilizes the voltage.

The current consumed by the keyfinder is below the breakdown current for the zener and the 3v9 zener does not drop the full 3.9volts. It only drops about 2v and about 4v appears across the chip, but this does not matter. When the circuit beeps, the supply drops to about 3v and this causes the tone to change but the operation is not impaired.

The output of the keyfinder is taken to a Schmitt trigger via a delay circuit so that the globe changes state only once for each beep.

The delay consists of a 1uF electrolytic and is charged via a single diode. When a beep is emitted, the positive portions of the waveform charge the electrolytic and this voltage appears on the base of the first transistor in the Schmitt trigger.

The 1M is designed to fully discharge the 1uF between beeps so that the Schmitt trigger resets after each beep and the 100k increases the impedance as seen by the delay circuit so that only one pulse is generated.

The Schmitt trigger converts a slow waveform into a high speed pulse and this is passed to a buffer transistor, via a 22n capacitor, to clock a

flip flop. The flip flop is wired in TOGGLE mode in which the output changes state each time a transition is detected on the clock line.

The output of the flip flop operates a globe via a buffer transistor and the circuit remains in either of its two states until the next whistle is detected.

Each time a tone of the correct frequency is detected, the chip is activated and responds with a chirp. At the end of the chirp the globe changes state.

For the first generation of keyfinders, the chirp occurs only once, but the third generation has a 3-chirp circuit and since this is an odd number, the WOX finishes up changing the state of the globe!

The clean operation of the circuit revolves around the characteristics of the Schmitt trigger and we will cover it in some detail.

The Schmitt trigger section consists of the first two transistors and these are directly coupled. When one is turned ON, the other is OFF.

But the reason why the circuit acts quickly to an input waveform is due to the feedback arrangement of the two emitters.

They form a feedback path with a 22k resistor to the negative rail and this is the secret to how the circuit works.

During rest conditions, no voltage is present on the base of the first transistor and thus it is off. The voltage on the collector is theoretically HIGH and this turns the second transistor ON. This makes the voltage on the collector of the second transistor LOW.

Due to the current flowing in the circuit, a very small voltage appears across the 22k resistor and it is this voltage that is so important.

The circuit remains in this state until a beep is produced by the keyfinder.

When this happens, the waveform is rectified by the diode and charges the 1uF electrolytic. This voltage appears on the base of the first transistor, via the 100k resistor and begins to turn it on. The current through the collector-emitter junction of the first transistor robs the second of turn-on current and Q2 begins to turn off.

The voltage across the 22k reduces and this creates an increase in potential between the base and emitter of the first transistor.

The net result is the first transistor turns ON harder and the two change state almost independent of the input voltage.

At the conclusion of the exchange, the collector of the second transistor is HIGH and the 22n discharges through the 1M and 2M2 resistors.

The beep ceases. The charge on the 1uF is bled via the 1M and the voltage on the base of the first transistor drops.

In doing so, the collector voltage rises and turns ON the second transistor. This makes the collector voltage of the second transistor fall and it draws the 22n capacitor down with it. This action occurs very quickly and the base of the BC 557 is given a sharp pulse to turn it ON.

The collector voltage rises rapidly and clocks the flip flop. The output of the flip flop is taken to the base of a BC 338 via a 330R resistor and this transistor is a buffer to operate the globe.

ASSEMBLY

All the components fit onto a WOX PC board and three leads are taken to a "keyfinder". Refer to the diagram on the previous page for the wiring guide.

To build this project you will need the WOX kit of parts, PC board and a keyfinder. If you do not have an old keyfinder, one can be purchased, as an extra, when ordering the WOX kit.

When you have all the necessary parts, assembly can begin.

Firstly mount the IC socket, then each of the components as per the overlay on the board.

Take care with all the polarized components (the diode and electrolytics) and fit everything close to the board to make it look professional.

The 4 transistors are fitted so that the "D" on the board matches the shape of the case and the leads are bent very slightly so that they fit down the holes on the board.

Don't forget to fit the IC so that the notch (or cut out) at the end of the chip goes over the dot on the board.

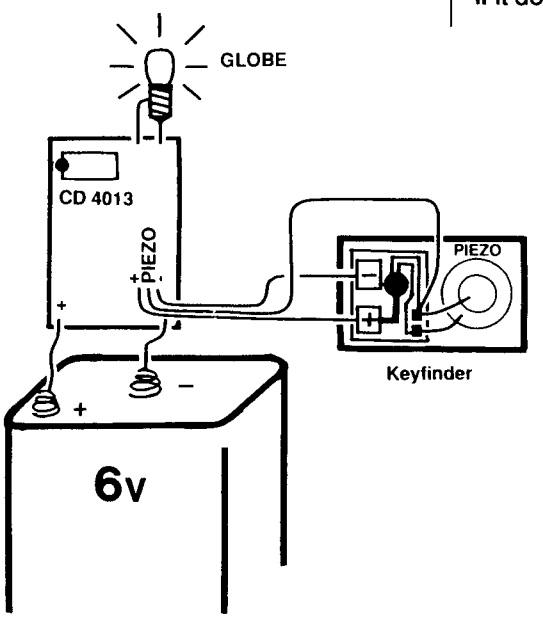
If the chip does not have a notch at one end, it will have a dimple, indicating Pin 1 and this dimple is at the same end as the notch.

The globe is fitted via two short pieces of tinned copper wire so that it stands off the board.

Tinned copper wire is also used to connect the board to the spring terminals on the lantern battery

Three pieces of hook-up flex connect between the board and the keyfinder as shown in the diagram. The positive and negative leads are the power leads for the beeper chip and these are the same for all the keyfinders.

The position of the third lead, however, will vary according to the style of keyfinder you have. There are only two possible positions and if it does not work on one side of the



Connecting the WOX board to the Keyfinder is very easy. The only problem is the variety of Keyfinders. We found 3 different types and a little experimenting may be necessary.

The buffer on the output of the schmitt trigger is designed to increase the amplitude of the schmitt section to provide a guaranteed high/low to clock the flip flop.

piezo diaphragm, try the other side.

It is important not to remove the piezo from the case as this will cause it to lose its sensitivity.

For the piezo to be sensitive, the outer edge must be held rigid.

When a tone of the correct frequency is presented to the diaphragm, the plate vibrates and creates a waveform that is passed to the input of the chip.

Sensitivity is also increased by clipping the two halves of the case together so that the case acts as a sounding-board.

Connect the lantern battery and the project is ready for testing.

You will need to whistle at the correct frequency to activate the keyfinder and the response will be to turn ON the globe at the end of the beep. If this does not happen you will need to read the next section.

IF IT DOESN'T WORK

If the keyfinder does not respond to your whistle, you will have to determine if the unit is working or if it has been damaged.

Ideally, you will have already proven this before taking it apart and you can either "borrow" a couple of button cells or wire up two penlight batteries to supply the chip with 3v.

Once you are satisfied the keyfinder works, connect only the power leads to the WOX board and not the third lead as it may be shorting out the signal from the piezo and preventing the circuit from detecting a tone. Try the circuit.

Connect the third lead and make sure is doesn't prevent the circuit from operating.

If a beep is produced but the globe fails to change state, the fault will lie on the WOX board.

The board is tested "backwards". This means we start at the output and work towards the input.

Begin at the output and short between collector and emitter of the BC 338 with a jumper lead. This will turn the globe on. If not, the globe is "blown" or the battery is not connected.

Next connect the jumper between the collector and emitter of the BC 557. This will clock the flip flop and make the globe come on. If it doesn't, connect a multimeter to pin 3 and make sure the input changes from LOW to HIGH, when the jumper is connected.

If the line does not change, the transistor may be leaky and preventing the line going low.

When you are sure the input clocks correctly, test output pin 1 for a LOW-HIGH transition.

If the output does not change state, check the power rails of the chip and maybe replace it with another.

Next test the BC 557 buffer transistor. Short across the 1M (on the collector of the second transistor) and this will trigger the BC 557 via the 22n capacitor, when the short is removed.

If this fails to activate the globe, connect a 100k between base of the BC 557 and negative, very briefly, and repeat the action a few times.

This will clock the flip flop and turn the globe ON-OFF.

If this fails, the BC 557 is faulty, the 2M2 is not the correct value (too low) or the 100k is not connected (the clock line is not going low).

The transistors in the Schmitt trigger cannot be tested individually as they work as a pair and the circuit is high impedance so that a good quality multimeter is needed to prevent loading the circuit.

To test the change of state of the Schmitt trigger, measure the voltage on the collector of the second transistor when the circuit is at rest and determine it is LOW.

Fit a 100k between the positive rail and 1uF electrolytic. This will cause the collector of the second transistor to go HIGH.

This is as far as you can go with simple tests and a CRO will be necessary to see the waveform from the beeper being integrated by the delay, charge the capacitor and turn ON the Schmitt trigger.

This covers the whole circuit and your project should be working perfectly.

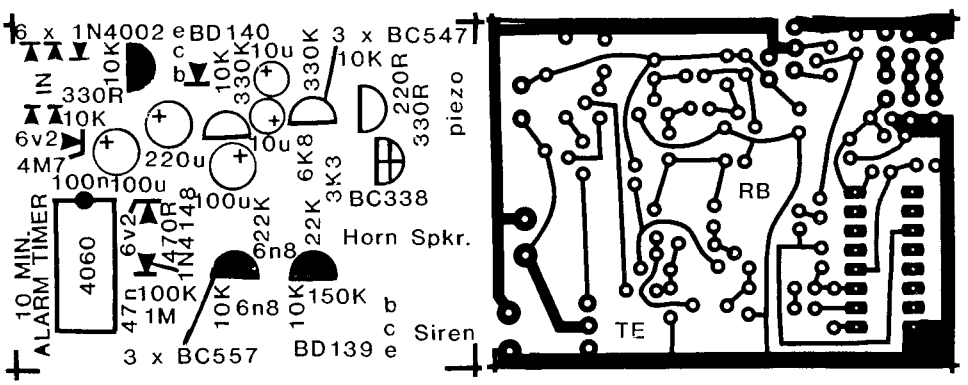
Try activating the WOX from a distance and make sure it doesn't false trigger from surrounding noises.

You can use it beside your bed or in a long dark passage, providing you can whistle when you are scared.

I hope you find your own uses for the WOX and it proves to be a useful project.

.....cont from P. 47.

10 MINUTE ALARM TIMER ARTWORK



For those who make their own boards, here's the full-size artwork . Remember, all boards in our kits come with an overlay to make parts placement and servicing easy.

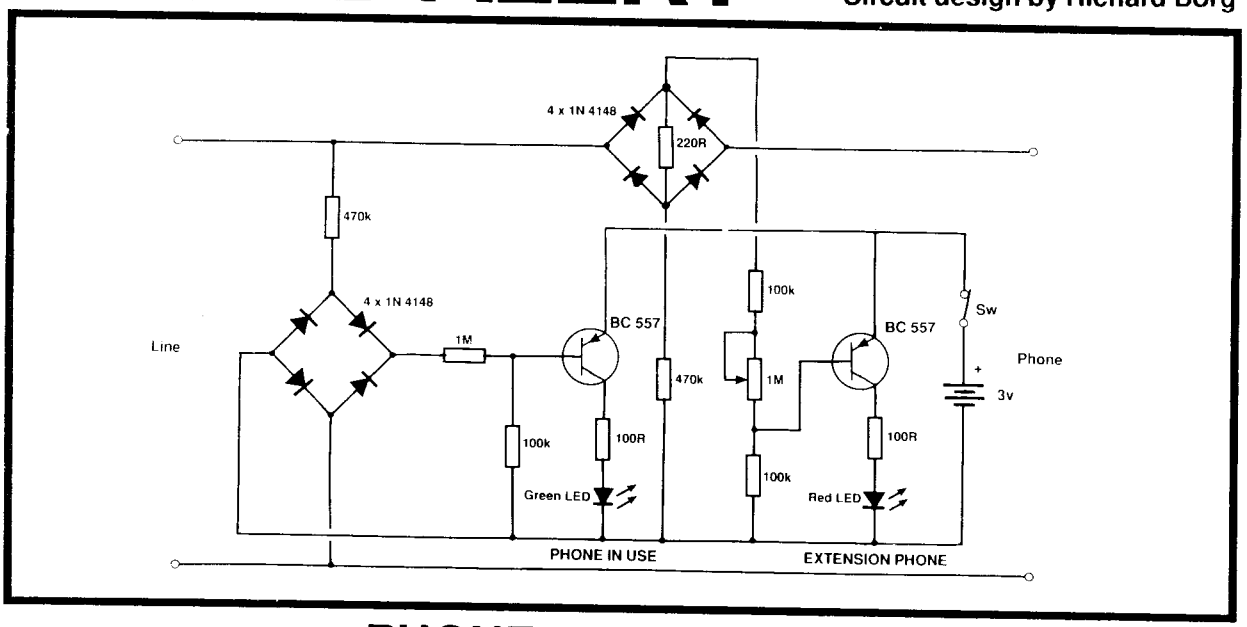
It is practically impossible to service anything that doesn't have an overlay and anyone thinking of making a board without this guide is only ruining a good project.

Build TE's . .

PHONE ALERT

Parts: $14.35
PC board: $2.00
Total: $16.35

Circuit design by Richard Borg



PHONE ALERT CIRCUIT

This project has two features.

It will let you know when the line is in use from one phone or the extension.

The green LED indicates one phone and the red LED indicates the extension.

There are many times when you need to know the state of the phone line and this project will prove to be invaluable.

It will prevent you picking up the phone when the extension is being used but most important it will indicate when the extension has been picked up when you are on the line.

In some cases the extension will make no difference to the sound level on the main handset and the extension party can listen in without being detected.

This is what this project is all about. It picks up that "sneaky" extension phone and alerts you to its "tap."

There are quite a number of PHONE ALERT products on the market and although I have not seen them all, the ones I have tested failed to work.

They failed because no one has ever tried them!

The phone system is much more complex than you think and when a mechanical and electronic phone is connected to the same line (the same two wires), it is not possible to detect the electronic phone when the mechanical is in use.

The reason for this is the mechanical phone drops the line voltage to about 3-5v while the electronic phone drops the line voltage to about 15v. (when they are on the line separately).

This means they are different impedances (different resistance) and when they are on the line at the same time, the electronic phone drops the line voltage only about a further .5v over that of the mechanical phone.

This is a very small change and since the voltage across the mechanical phone is not always the same, there is no way of setting a detection point.

It is not possible to detect the extension by using a series LED or parallel LED to cover all the possible combinations where the detection unit is placed with respect to the high and low impedance phones.

PARTS LIST

2 - 100R
1 - 220R
3 - 100k
2 - 470k
1 - 1M

1 - 1M mini trim pot

8 - 1N 4148 diodes
2 - BC 557 transistors

1 - 5mm green LED
1 - 5mm red LED

2 - LED holders
2 - AA cells
1 - SPDT mini slide switch
1 - phone tee piece
1m - 3-wire ribbon cable
1 - plastic box and lid
2 - 15cm hook up flex red & black
1 - 15cm fine solder

1 - PHONE ALERT PC BOARD

Furthermore, any circuit using the phone line to drive the indicator LEDs will result in very poor brightness as the line does not have enough energy in reserve, when the phone is being used.

With a mechanical phone there is only about 3-5v available and you can only draw about 1mA in parallel mode. Even with a flasher chip the effect is far less than acceptable.

In the series mode you cannot detect the extension phone unless the main phone is picked up and so a simple series or parallel mode will not work.

What is needed is a combination of both parallel and series and after a lot of experimenting, this project solves the problem.

One of the first things we realised is the need for a 3v supply to give the LEDs the brightness they need - using the phone line is useless.

Power is only consumed from the battery when the handset is lifted and the battery will last many hundreds of hours.

The clever part of the circuit is the use of both series/parallel bridges.

The parallel arrangement is easy to understand. It detects a drop in line voltage when either phone is lifted, and causes the green LED to turn ON.

When both phones are on hook, the line voltage is about 50v and a voltage divider made up of the 1M, 470k & 100k, reverse biases the base of the BC 557. This keeps the transistor switched off and the LED is not illuminated.

When the line voltage falls, the base voltage is pulled lower than 3v (actually 2.35v) by the 100k and thus the transistor is turned on.

Now we come to the clever part of the circuit.

Connected between the phone and the exchange is a SERIES BRIDGE with a 220R load resistor.

When the "home" phone is lifted, it puts a voltage across the 220R so that a "turn off" voltage is still generated on the base of the second BC 557 to keep the red LED off. When the extension is lifted, the voltage falls away and the red LED turns ON. The effect of the 220R is to multiply the voltage drop caused by the extension phone, to about 2v and now we can reliably detect the extension being picked up.

CONSTRUCTION

All the components mount on the PC board except the two LEDs.

They fit onto the end of the plastic box via two LED mounts and connect to the board via leads.

The two penlight cells are soldered directly to the board via wires and this saves using a battery holder.

Begin assembly by fitting the resistors and use the overlay on the board to identify where each goes.

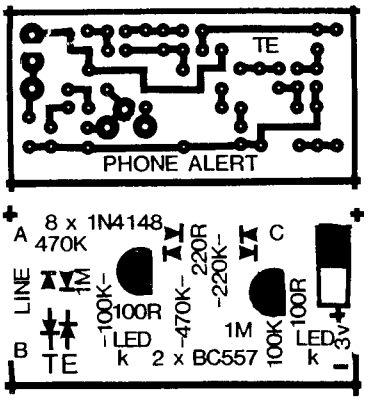
Next fit the 8 diodes and two transistors. Make sure you don't take too long when soldering these as they can be damaged if they get too hot.

The last components for the board are the mini slide switch and mini trim pot.

Prepare 4 lengths of hook-up wire 5cm long for the LEDs and make sure the black leads connect to the negative on the board. The red leads are taken to the anode holes on the PC board.

Drill two 5mm holes in one end of the plastic box and ream them out slightly with a tapered reamer to take the LED mounts. Fit the two LEDs and glue them in position with Tarzan's grip to prevent them from moving.

Cut the leads short and make sure the cathode lead remains shorter than the anode lead.



The Phone Alert artwork

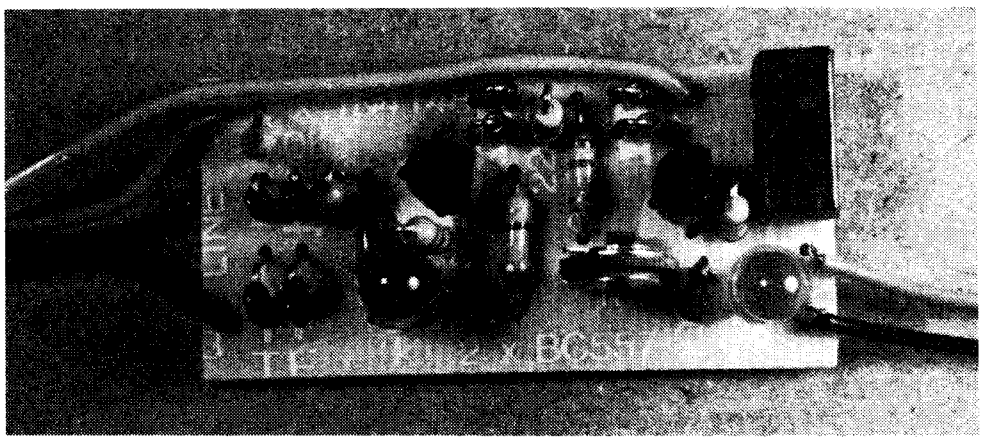
Drill a 3mm hole in the other end of the box and push the ribbon cable through. Connect the leads to the tee piece as shown in the diagram and connect the other ends of the cable to the 3 positions on the PC board.

Make sure the positive of the phone line goes to the top of the circuit as shown in the circuit diagram.

Solder the 4 wires to the LEDs so that the black leads go to the cathode (the shorter leads) and the two red wires to the anodes.

Solder the two penlight cells together with tinned copper wire and use the remaining hook-up flex to connect them to the PC board.

CAUTION: Do not use a 9v supply for the project as the LEDs will not turn off when the tee piece is connected to the phone line.



A close-up of the phone alert board. The LEDs can be mounted on the end of a small jiffy box as shown on P 57.

The project is now complete and before the Tee piece is connected to the phone line, slide the power switch ON and the two LEDs will illuminate.

This shows the project is working correctly and you are ready for connecting to the phone line and adjusting the mini trim pot.

IF IT DOESN'T WORK

The tee piece is NOT connected to the phone line for these tests.

If the LEDs do not come on, or if one LED doesn't come on, the most probable cause is a damaged LED due to soldering or a reverse-biased LED.

Try the LED(s) around the other way or a new LED. They can be easily damaged by too much heat and if this is the case, they will lose their brightness.

If one or both LEDs still do not come on, short between collector and emitter of each transistor and if the associated LED turns ON, the transistor is not switching. This may be due to the base voltage not being low enough or the transistor being damaged.

To test the transistor put a 1k resistor between base and negative to force the transistor to turn ON.

If this is successful, you should remove the 1M resistor from the parallel bridge to see why the base is not turning on. The only possible explanation is an open connection to the base and you should look at the trackwork.

The same applies to the second LED. Remove the 1M mini trim pot and check the circuit. A fault must be present that is preventing the base turning the transistor ON. In other words the base is not going lower than 2.5v. Don't forget, we are using PNP transistors and when the base falls to 2.35v, the base-emitter voltage is .65v and the transistor turns ON. If the base is 2.5v, the base-emitter voltage is .5v and the transistor will not be turned ON.

With both handsets "on hook," connect the tee piece to the phone line and both LEDs will go out.

If not, a fault will exist in the biasing network.

To test the green LED section you will need a good quality multimeter such as 30k ohms/volt or greater as the voltages we are measuring are high impedance. Make sure all the components are fitted, especially after experimenting, and measure the voltage between the negative rail and base.

It should be 3.5v and if the green LED does not turn off fully, the 1M can be reduced to 470k or even lower.

When this section is working, go to the red LED.

The same applies to the base of this transistor. The voltage should be higher than the positive rail and may be as high as 9v when the handsets are on the hook. If this voltage is not present, either the transistor is faulty or a leak exists on the board that is preventing the voltage from appearing.

When the "home" phone is lifted, the line voltage drops and the green LED turns ON as the "turn off" voltage disappears and the 100k pulls the base towards the negative rail.

But the red LED does not turn ON due to the series bridge creating a different effect.

This time the voltage appearing across the 220R adds a few extra volts to that appearing across the home phone and prevents the red LED from illuminating.

You should measure the voltage across the 220R. It should be between 3-5v, depending on the type of phone in use.

When the extension is picked up, this voltage drops 2v and the line voltage drops about .5v, making a total of 2.5v, removing the "turn off" voltage and the red LED comes ON. The current consumption from the 3v supply will help in diagnosing any further problems you have.

When the project is at rest, the current is zero. When the green LED is on , the current is 4mA. When both LEDs are On, the current is about 6mA.

FITTING INTO A BOX

When you are satisfied the circuit is operating correctly, fit the PC board into the plastic box and hold it in position with double-sided foam tape. Lay the batteries beside the board and hold them in place with tape also.

Drill a hole in the side of the box to align with the mini trim pot so that you can use a micro screwdriver to adjust it.The project is now ready for setting up.

SETTING UP

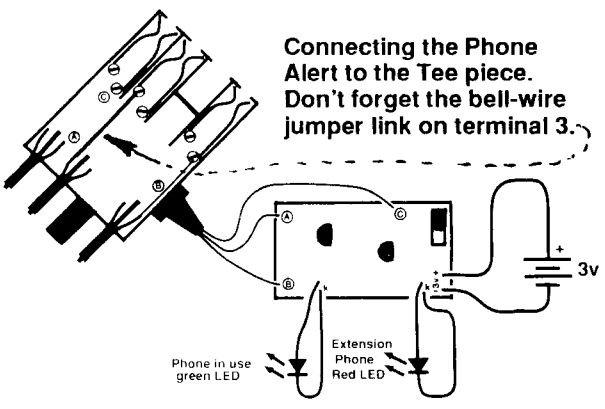
The final stage is to adjust the mini trim pot to pick up the extension phone.

Fit the tee piece to the line and pick up the "home" phone. Only the green LED should come ON. Adjust the pot so that the red LED is just off. Pick up the extension phone and the red LED will turn on. Replace the extension and the LED will go out.

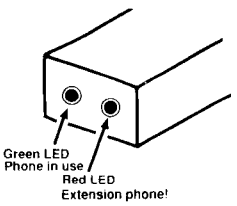
When only the extension is picked up, both LEDs will illuminate.

This circuit is very sensitive and will pick up the slightest drop in line voltage.

Let's hope it prevents any further embarrassing moments when dialing out over the extension's conversation.



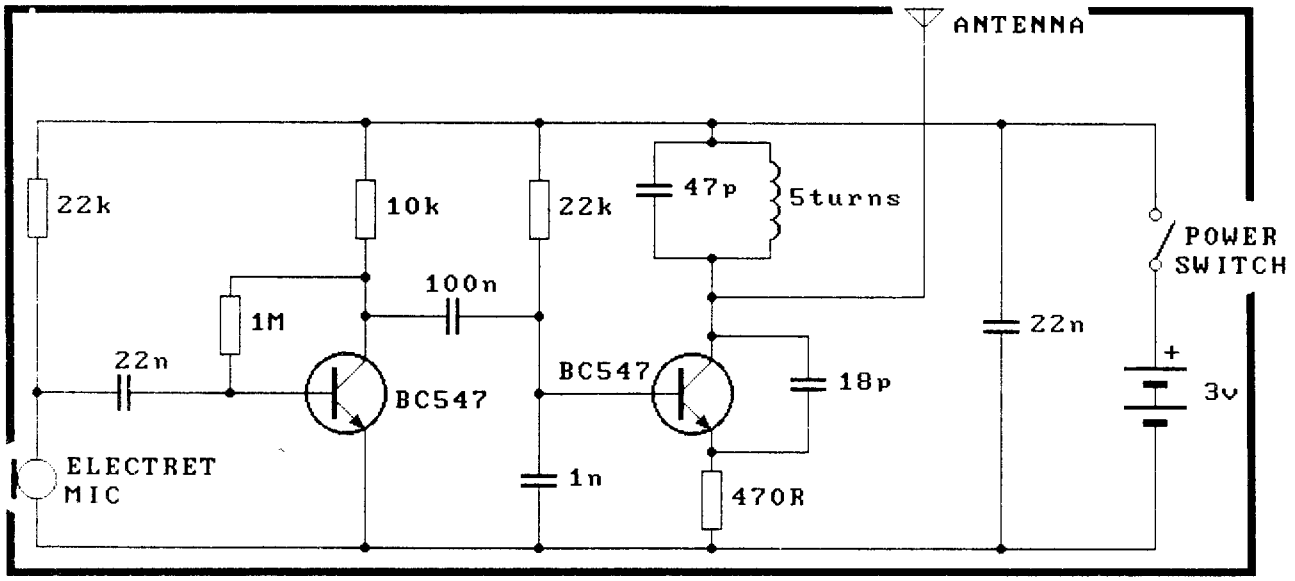
Connecting the Phone Alert to the Tee piece. Don't forget the bell-wire jumper link on terminal 3.



EARWIG

A Bug in a matchbox

Parts $6.85
PC board $1.70
Total $8.55



EARWIG CIRCUIT

This is an easy to build FM transmitter that fits into a matchbox. It transmits to any standard FM radio and can be used around the home as a baby minder or outdoors for up to 300 metres. Its sensitivity and clarity are very impressive - even the ticking of a clock can be picked up 3 metres away.

Almost everyone has the ambition to use the airwaves. Whether it be for remote control or transmitting halfway around the world, we all love to broadcast.

This project will get you on the air with the least fuss and you can build two units to achieve a two-way link over a range of 300 metres or so.

We've called the project EARWIG because an earwig is a small bug and so is this.

The concept of FM transmission is superb. It produces an extremely high quality signal that is noise-free and it is relatively easy to get a good range with low power.

The Earwig produces no more than 8-10 milliwatts of radiated signal and yet the range is quite impressive.

Buildings and high-voltage transmission lines have an effect on the range and they can sometimes limit the signal to less than 100 metres. But this will be very rare as the signal finds its way through and around obstructions with very little trouble.

The most challenging part of this project is to achieve the best range using 1/2 wave antenna and 3v supply.

By constructing the Earwig, you will learn a lot about FM transmission and see how effective it is.

The first question you may ask is: "How can I increase the range?" The answer is not as simple as it seems. A lot of complications creep in when the voltage and power are increased and we must warn you that serious interference may occur to TV sets when you start increasing the supply voltage.

Everything is quite safe when you are down at 10 milliwatts and although you can achieve 300 metres, the signal strength at this distance is only a few microvolts and you are almost down to snow.

These FM transmitter projects are for interest and educational purposes only and have a magnetic draw about them.

You can spend hundreds of hours experimenting and improving the design and sometimes you come right back to square one.

We have done all the experimenting for you and come up with the simplest and best design. It is small enough to fit inside a match box and comes with a 15cm antenna for inter-room communication.

We have had a unit running for nearly 12 months. It sits on top of the TV during news and similar programs and the writer has an FM radio next to his typewriter. He can monitor the TV while typing and if an important item comes up, he can rush in and watch it.

PARTS LIST

1 - 470R
1 - 10k
2 - 22k
1 - 1M

1 - 18p ceramic
1 - 47p
1 - 1n
2 - 22n
1 - 100n monoblock

2 - BC 547 transistors

1 - electret mic insert
1 - mini slide switch
1 - 5 turn coil 3mm dia tinned copper wire
2 - 'N' cells
1 - 15cm tinned copper wire for short antenna
1 - 170cm antenna wire

1 - EARWIG PC board

Mind you, most programs need very little viewing and when the adverts come on, you can turn the radio down for up to 2 minutes. It's amazing what can be done in two minutes!

The Earwig can also be used as a baby monitor for those times when you are next door or in the garden.

It's left in the children's bedroom and if they wake up and start crying, you can attend to them quickly.

The unit looks a bit like a video sender and you can use any one of a number of boxes to house the circuit: or, as we have suggested, you can use the humble matchbox.

The current consumption is less than 5 milliamps and you should get between 80 and 100 hours of operation on two 'N' cells.

The circuit has been designed for maximum output rather than immunity to stray capacitance and although it has a very low drift factor, it is not possible to touch the circuit without it drifting off frequency. A 'tight' circuit will be described in another project as the output has to be kept to a minimum if the frequency is to be stable when the circuit is handled.

Although the circuit is not crystal locked, the frequency drifts very little in normal operation and our tests showed a receiver did not need re-tuning after an 8 hour test. The only thing that will influence the output frequency is the condition of the batteries. As they age, the frequency changes slightly.

A reduction in the transmitting range will indicate the voltage has fallen to the minimum allowed and the cells should be replaced. They are soldered together to fit inside the matchbox and provided they are soldered quickly, the seal on top of each cell will not be damaged and they will not leak.

All the components are easy to obtain and if you know what you are doing, you can use parts from your own sources. If you have any hesitation about wire size, coil diameter, identifying a monoblock capacitor, reading 10p or 1n on a ceramic or the type of electret microphone to use, you should buy a kit.

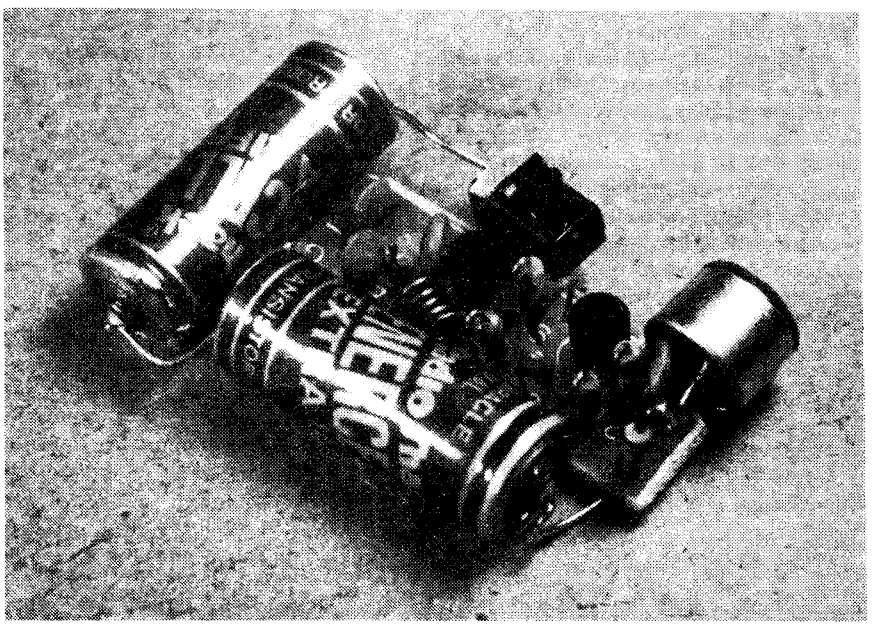
Kits are available from Talking Electronics as are ALL our projects, and the complete kit of parts includes a prewound coil and PC board with an overlay. The only item you need to buy is a matchbox and perhaps a few fake matches.

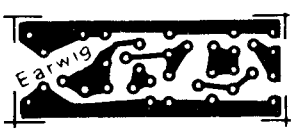
HOW IT WORKS

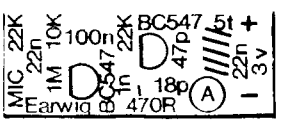
The circuit consists of two stages, an audio amplifier and an RF oscillator.

The electret microphone contains a FET transistor and you can count this as a stage if you wish. The FET amplifies the change in capacitance of the diaphragm at the front of the microphone and this is why electret microphones are so sensitive.

The first transistor is the audio amplifier stage and has a gain of 20 to 50 and amplifies the signal for injection into the base of the RF oscillator stage.







A close-up of the Earwig and our new, modified artwork for the board. Our photographer photographed our earlier model!

This stage is designed to operate at 88MHz and the frequency is set by the inductance of the 5-turn coil, together with the 47p capacitor. The frequency is also determined by the transistor, the 18p feedback capacitor and also to a lesser extent by the biasing components.

When power is applied, the 1n base capacitor will gradually charge via the 22k resistor. But the 18p will charge much faster, via the oscillator coil and the 470R resistor. The 47p will also charge (although only a very small voltage will appear across it) and the coil will produce a magnetic flux.

As the base voltage gradually rises, the transistor will turn ON and effectively put a resistance across the 18p.

A few difficult-to-describe cycles will now occur while the 1n charges to the operating voltage of the stage and we will resume our discussion when this is nearly reached.

The base voltage will continue to rise and the 18p will have the effect of trying to prevent the emitter from moving. A point in time is reached when the energy from the capacitor is exhausted and it can no longer resist the movement of the emitter. The base-emitter voltage decreases and turns the transistor off. The current flow in the coil then ceases and the magnetic flux collapses.

This collapsing magnetic field produces a voltage in the opposite direction and whereas the collector voltage may have been 2.9v, it will now rise to over 3v and charge the 47p in the opposite direction. This voltage will have the effect of charging the 18p and the voltage drop across the 470R emitter resistor will be such that the transistor will be turned more firmly OFF.

As the 18p charges, the emitter voltage will drop to a point where the transistor will begin to turn ON and the current flow through the coil will oppose the collapsing magnetic field.

The voltage across the coil will reverse and the collector voltage will drop. This change will be passed on to the emitter via the 18p and the result will be that the transistor will turn ON very hard and short out the 18p. After this the cycle begins again.

What we have is an oscillator circuit that produces AC energy at 88MHz with the amplified audio signal fed into this stage via the 100n varying the frequency of oscillation to produce the FM signals.

CONSTRUCTION

Before commencing construction it's a good idea to place the two cells and PC board into the matchbox and see how much room you have. The

headroom is most critical as you need to leave space for a single row of matches on a thin sheet of card. In fact you can glue a few dead matches on the card to add more reality.

Lay all the components on the work bench and identify each of them. There's nothing more annoying than putting two components on the board incorrectly and having to change them later.

To avoid this, place the parts so that they match the positions on the board. This will allow you to concentrate on soldering.

The solder we recommend is superfine .71mm resin core type, as thin solder makes a much neater connection. As one salesman told us "It goes twice as far!"

A small 15 to 20 watt iron is needed and provided the tip is cleaned on a wet sponge before starting, you will have no trouble in producing a first class job.

The only item that needs fabricating is the coil. It can be wound with .5mm or .71mm enamelled or tinned copper wire.

Although the wire diameter is important, it is not as critical as the number of turns, the diameter of the coil or its length.

Wind 5 turns on a 3mm diameter shaft such as a medium Philips screwdriver and space the turns as shown in the photos, over about 5.5mm.

Final setting of the frequency will be done by stretching the turns apart or squashing them together and at this stage the coil is ready for fitting. If you have made the coil from enamelled wire, the ends should be tinned up to the point where they enter the PC board. This tinning is done while the coil is on the screwdriver to act as a heatsink and any surplus solder should be removed so that the ends will fit down the holes in the board.

Now you can wire up the PCB (printed circuit board). Start at the microphone end of the board but leave the microphone to last to prevent the leads being damaged when fitting the rest of the parts.

The resistors stand on end and fit firmly up to the board, to keep the height to a minimum.

Continue across the board, fitting each part as you come to it. The transistors should be pushed down so that they are only as high as the other components. Add everything, including the microphone and finally the batteries, switch and antenna.

The batteries are soldered together by using the switch and some tinned copper wire at one end and soldered to the board with a short length of tinned copper wire from the positive terminal and hook-up wire from the negative terminal.

Solder 15cm of tinned copper wire to the point marked "A" on the board and construction is complete.

WHY?

Have you ever wondered why a circuit doesn't work? How many times have you built a project from a magazine and it doesn't function as described?

Don't blame yourself or blame the magazine. Most of the time its due to a factor called tolerance.

As made by the manufacturer, all components have a value falling inside a "spread range" rather than the nominal value marked on them. The width of this range is known as the tolerance. So if the tolerance is said to be 5%, it means the value of a particular part will be anywhere between 5% below and 5% above its marked value.

Tolerance applies to resistors, capacitors, transistors, microphones, coils integrated circuits and almost anything you can think of.

Then we have another factor called limits. For each component in a circuit there will be a range of allowable values for that part. Providing the value remains inside that range, or inside the limit, the circuit will work properly. Normally each components value is chosen so that it falls inside this range.

Most circuits are not very critical and for any particular component they will generally work equally well if we select the next higher or lower value. If not, the circuit is either very critical or the chosen value is the most appropriate.

When you place a circuit on the open market, such as in a magazine, you have an enormous range of potential builders, drawing their supplies from many different sources. Sometimes they use the designated values and sometimes they select the next value. Also some components have a close tolerance while others have a wide tolerance, such as +/- 50% When the spreads and limits are combined in a random manner, you can quite often end up with a circuit that doesn't work!

Take the electret microphone for example. On a 3v supply, some microphones are super-sensitive with a 100k load resistor. Others may require 4k7 to get a barely acceptable sensitivity. You can not tell the two apart from the outside. They both look the same. But electronically they are quite different.

We are talking here of hundreds of percent difference, whereas the manufacturer's specifications state one has a sensitivity of -22dB and the other -54dB. In simple terms we can say every 3dB down is twice the sensitivity, making the -54dB unit about 2,000 times more sensitive!

The same can apply to transistors. The specification sheets may show two devices to be nearly the same and yet when they are connected to a circuit, one will work perfectly while the other will fail to operate.

This is one of the reasons why the kit market has flourished. Kits are generally put together from batches of parts that have been tried in the circuit and for this reason we are advocating first-time constructors invest in a kit.

You have the greatest potential for success and nothing is more encouraging than success.

SETTING UP

Once all the components have been soldered in position, the project can be set up and tested for performance. The test procedure is to add a short antenna (about 5 - 15cm long) to the antenna point on the board and tune an FM radio across the band, looking for the signal.

It is best to keep the transmitter some distance from the radio, to prevent any of the harmonics (side tones) from being picked up.

If you cannot detect the carrier, it may mean the frequency is below the band. Move the turns of the oscillator coil apart a little and try again. If you are using tinned copper wire, make sure none of the turns are touching. If you are using enamelled wire, make sure the coil has continuity by either measuring it with a multimeter set to low ohms or measuring the current taken by the circuit, which should be about 4-6mA.

Once the carrier is detected, you can check the sensitivity of the front end by placing the Earwig near a clock. The ticking should come through loud and clear and the circuit should be more sensitive than your ear.

The load resistor for the electret microphone (22k) will determine the sensitivity and it may have to be lowered to 10k or raised to 47k, depending on the sensitivity required.

Make sure the frequency of transmission is well away from any of your local FM radio stations as a signal from a station will swamp the Earwig when you are testing for range.

By moving the turns of the coil together, the frequency will be lowered and if the turns are spread apart, the frequency will increase. This saves using a tuning capacitor and keeps the cost down but you can use a trimmer if you wish.

A word of assistance here. If you use a 5-65p air trimmer, for example, it will be very difficult to tune the circuit to a

specific frequency as a few puff (picofarads) will change the frequency by 1MHz or more. It is better to use a 39p ceramic and put a 4-11p trimmer across it. This way you are fine tuning the circuit and you have much more lee-way with adjustment.

Theoretically the inductor should also be adjusted to maintain the L/C ratio of the tuned circuit, but over the small range we require, this is not critical.

The output power of the Earwig can be determined by using an FM radio with a tuning indicator. You really need to have a comparison as 4 divisions on the meter of our tuner indicates a very good output. We tested the output of our prototype with a 15cm length of antenna laying horizontally and about 10 metres from the tuner. With 4 divisions we know the transmitter will be capable of transmitting about 300 metres with a half wave (170cm) antenna.

IF IT DOESN'T WORK

Hopefully the Earwig will work first go for you, but if it doesn't, you will have a challenge. An educational challenge.

If you cannot pick up the carrier on an FM receiver you should firstly assume the frequency is below the normal 88-108MHz band.

Measure the current. If it is about 4-6mA, the circuit will be operating. Move the turns of the coil apart and sweep the band with the radio. When touching any of the parts on the board, make sure you use a non-metallic screwdriver and also keep away from the batteries etc.

The capacitance effect of your hand will detune the circuit appreciably and it may drop out completely. It all depends how critical the tolerance values are, in your case. It is also important to keep to the 3v supply and place the batteries close to the board, as shown in the photos. Don't use a plug pack or power supply to derive the voltage as the circuit may not like the characteristics of a generated supply.

The whole layout must be exactly as shown to maintain the same circuit capacitances. Once you get the circuit working, you can change the arrangement but during the initial test procedure, everything must be as shown.

The oscillator is operating at about 88MHz and unless you have a 100MHz CRO, you cannot detect the output waveform. If you are fortunate enough to have a frequency counter, the antenna can be connected directly to the 75 ohm input and the frequency measured.

Otherwise it will be necessary to make some DC voltage readings to see if the oscillator transistor is biased correctly.

Measure the base voltage and also the emitter voltage. An ordinary voltmeter will indicate about 2v in both cases, due to the loading of the meter. Only a high impedance meter such as a FET meter will indicate 2v on the emitter and 2.5v on the base.

If a voltage is present in both cases, you can assume the transistor is operating, but it may be transmitting at the wrong frequency.

The 18p feedback capacitor suits a BC 547 transistor. If you intend to use another type, the value can be decreased to 10p or 5p6. Try changing this capacitor first, then the transistor.

Simple things such as shorts on the PC board, broken tracks, poorly soldered joints or unmarked components are always a possibility. Especially components with poor markings. If you are unsure about the value of a component, replace it immediately. It could be ten times the correct value, and the circuit will never work!

If you are detecting a carrier but no audio, the fault will lie in the audio stage and/or the microphone. These two sections can be tested with a CRO and you can measure the audio signal to see what is being presented to the oscillator stage.

Without a CRO you will be stuck. Even though the voltage on the electret mic can be as low as 70mV to 1500mV, this will not indicate its sensitivity or if it is working at all.

A voltage of 1.4v on the collector of the audio amplifier will indicate the transistor is turned ON and if it is below .8v, the transistor will be saturated or possibly damaged in some way. It could also mean the transistor has a very high gain and will not be suitable.

If the voltage is above 2.5v, the stage will not be turned ON sufficiently and again, the transistor and bias resistor should be checked and/or replaced.

A CRO will also show the sensitivity of the microphone. By increasing or lowering the value of the load resistor, the gain of the FET can be changed. It should not go below 10k and may need to be as high as 47k, or higher, for extremely sensitive devices.

It works like this: for any electret microphone, reducing the load resistor will increase the sensitivity. The final value will depend on the quality of the microphone.

This is about as far as you can go with simple test equipment. If all fails, start again with a new kit. Sometimes something stupid has occurred such as swapping two components or reading the value of a resistor incorrectly and this will be extremely difficult to find.

FITTING INTO A CASE

All the components can be mounted in the tray of a matchbox and if the PC board is turned on its side, it will take up the least amount of space.

Cover the "works" with a single layer of matches, stuck to a thin piece of card and take the antenna out one end of the tray or up through the roof.

A small hole can be made in the other end of the tray to allow the sound to enter the microphone but this is not really necessary as the sound seems to get through, even when the drawer is closed.

If a hole is made in the side of the tray, near the switch, the circuit can be turned on by pushing a match through the hole and this will save removing the layer of matches.

We suggest only a very short length of antenna, about 15cm, to achieve a range of about 30 metres. This will be sufficient for inter-room communication and will be ample for even a large house.

The complete project looks very nice painted black, with the short antenna mounted upright to look like a video amplifier.

I know you will be impressed with its performance. After this, the next model to build is the Amoeba or Voyager and then the Spy Bug.

The Earwig fits into a matchbox and is covered with a layer of matches. The antenna can be a length of hook-up wire or fine enamelled wire.

THE AGE, Friday 1 September 1989

Bugging devices to stir the envy of James Bond

By DENIS WILLIAMS

Private detectives in Victoria are being offered telephone-bugging kits and listening devices by a Cheltenham manufacturer.

For $995 they can buy 28 bugs that normally sell for $1100.

A Telecom spokesman said yesterday that it would be "highly illegal for anyone to attach that equipment to the Telecom network". But attach it they do.

Included in the offer are a phone handset with alligator clips for checking phone lines and eight phone-tapping devices.

One, called Phone Bug PH-01, sells for $85 and is disguised to appear to be part of the telephone. It can transmit conversations up to 200 metres.

The PT-05 starts a tape recorder when the telephone is answered and uses a timing circuit to stop it after five minutes. "This allows you to get 12 calls on a C-120 cassette," says a brochure sent to the private detectives from Talking Electronics Pty Ltd.

A private investigator and former fraud squad detective, Mr David Lentin, said yesterday the phone-tapping equipment and listening devices were available to any "ratbag" who cared to buy them.

"These are very sophisticated and professional pieces of equipment, not playthings that schoolboys use for a bit of fun," he said. "James Bond would be quite happy to have access to them."

Some devices are ingenious. The Infinity Bug IBR 01 (at $195) can be attached to a phone line that services a room which a detective might want to monitor.

All he has to do is ring the number from anywhere in the world. The telephone will not ring, but it will be activated and anything said in the room can be listened to via the phone link.

The man behind the devices is Mr Colin Mitchell, 42, a former high school teacher and television repairman, of Rosewarne Avenue, Cheltenham.

He has just perfected a double-adaptor telephone jack that includes a tiny microphone he is very proud of. He is coy about its use. "I don't use these things," he said yesterday, "I just make them."

Picture: NEIL NEWITT

Mr Mitchell with the $995 kit: it includes phone taps and wall bugs. Even the briefcase has a built-in bug.

Mr Mitchell employs eight people to help with production.

Talking Electronics Pty Ltd has sold 20,000 phone-tapping kits. "God knows how many thousands of single items I have sold," Mr Mitchell said.

Asio

He has been making the equipment for three years and says he does not know what the people who buy it use it for.

"I have sold equipment to Asio and the drug police but I don't ask them what they are going to do with them," he said.

"We can make anything here. We can put bugs in pens, briefcases and we use a lot of plastic Tic-Tac lolly containers."

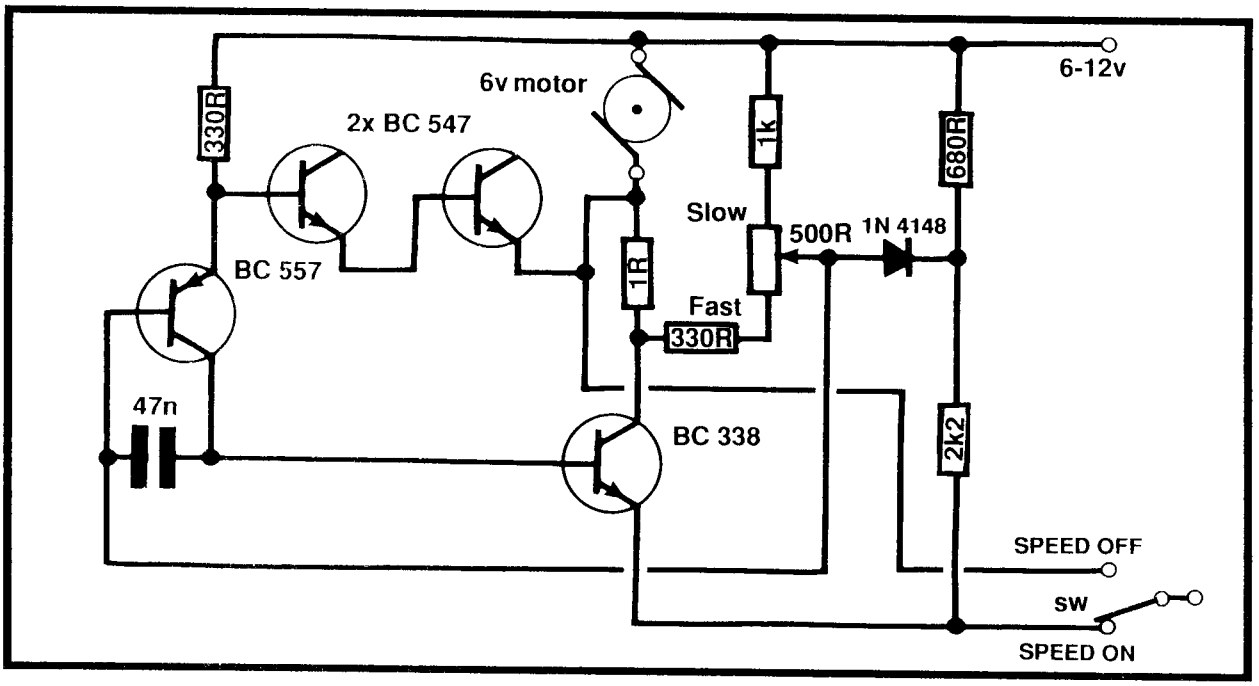
On the back of his latest device are the words: "Telecom Australia Engineering Approval Number c35/1/86." Does he have Telecom approval? "Good God no," he exclaimed with a huge laugh.

"Nothing that goes on here is illegal. We don't use them, we just sell them."

MOTOR SPEED CONTROLLER

Parts $6.60
PC board $2.50
Total $9.10

Slow-down any tape-recorder



Motor Speed Controller Circuit

One of the major requirements for a Private Investigator (PI) is a long-duration tape recorder.

When monitoring an environment where there is speech is to be picked up, above a background of noise, it is not possible to use a VOX system and the recorder must be left on continually.

A normal tape recorder, with one or two hour's of recording time will soon run out of tape and changing it every hour would be inconvenient.

A long play tape recorder is needed for the job and although they are available on the market, their cost is enormous.

For the cost a few dollars and a few hours work, you can produce an identical product. This project shows you how.

Firstly I must put you in the picture regarding the running time of long-play recorders.

Most advertisements promoting these devices claim 11 hour's recording time on both sides of a C180 cassette. It's bit like saying "my car will go 1,000km on two tanks of fuel."

You have to be present to change the tape at 5 1/2 hour's duration and so their claim is a trap.

All our calculations are based on ONE side of a C120 cassette and if you are able to get C180 cassettes, the times can be increased by 50%.

The second hidden factor with slowing down a tape recorder is the minimum speed at which it will guarantee to start up.

At the beginning of the tape, the strain on the motor is the least due to the take up spool being free to revolve. But as the spool fills up, it revolves slower and this puts more strain on the motor, due to the friction of the clutch.

If a recorder fails to start-up, it will do so when the take-up spool is nearly filled.

For this reason you will need a good quality player and new cassettes.

We have tried to slow a tape recorder down to 5 1/2 hours per side but it will not reliably start up in the automatic mode. The 11 hour models are for manual recording only.

To slow the motor down you could use a variable resistor. In a limited way this would work but apart from being wasteful on the battery, the torque of the motor would also be reduced by the fact that the series resistor would limit the current.

PARTS LIST

1 - 1R
2 - 330R
1 - 680R
1 - 1k
1 - 2k2

1 - 500R pot
1 - knob to suit

1 - 47n greencap

1 - 1N4148 diode
2 - BC 547 transistors
1 - BC 557 transistor
1 - BC 338 transistor

1 - SPDT toggle switch
6off - 10cm hook-up flex

1 - MOTOR SPEED CONTROLLER PC board

This in turn, would give you a variation in speed from the beginning of the tape to the end. But more important, you would not be able to reduce the speed significantly before the motor would stall.

The only successful way is to provide an electronic speed control.

The circuit we present in this article has 3 features.

Firstly it will control a standard 3 or 5 pole DC motor, or a motor with internal centripetal governor. Secondly, its pulse mode of operation is less wasteful than a dropper resistor and thirdly it provides an electronic interface between motor and battery so that motor noise is greatly reduced.

HOW THE CIRCUIT WORKS

The circuit starts up via the 1N 4148 diode, 680R and 2k2 resistor. These provide a turn-on voltage for the BC 557 transistor.

For a 6v supply, the 680R/2k2 combination provides 4.6v at the cathode and the anode end of the diode will not rise higher than 4.6v + .6v = 5.2v The base of the BC 557 sees 5.2v and the emitter is 5.2 + .6 = 5.8v. A voltage of .2v is developed across the 330R and this means a current will flow through the resistor, the BC 557 transistor and the base of the BC 338 transistor. The circuit is now turned ON and the 1N4148, 680R and 2k2 are no longer needed.

A voltage drop across the 1k and the setting of the 500R pot will turn ON the BC 557 even harder and also the BC 338, to give the motor a "kick start."

As the motor starts to revolve, it produces a back EMF and also "motor noise" in the form of spikes that go straight through the two junctions (made from two BC 547 transistors) to turn off the BC 557.

The motor speed is determined by turning ON the BC 557 fairly hard via the pot and allowing negative feedback via the two junctions to lower the "turn on" value. This becomes the NO LOAD requirement for the motor.

When the motor becomes loaded, its RPM reduces and the amplitude of the spikes is reduced. The BC 557 turns on harder and this effect is transferred to the BC 338. The circuit delivers more current to the motor and this causes it to increase in RPM.

The net effect of the circuit is to control the current to the motor and for a wide range of loads, the change in RPM is minimal.

ASSEMBLY

Fit the 12 parts to the PC board and solder them in place.

Add 3 lengths of hook-up flex to connect the pot to the board and 2 more to connect the switch to the board.

Refer to the sketches to see how this is done.

To install the board, measure the polarity of the leads going to the motor and determine the negative lead.

Cut the negative lead about half way and take the end that is connected to the motor to the hole marked on the diagram.

Take the other end of the negative lead to the middle tag on the toggle switch.

Finally, connect the positive lead of the motor to the "+" on the PC board.

SETTING THE SPEED

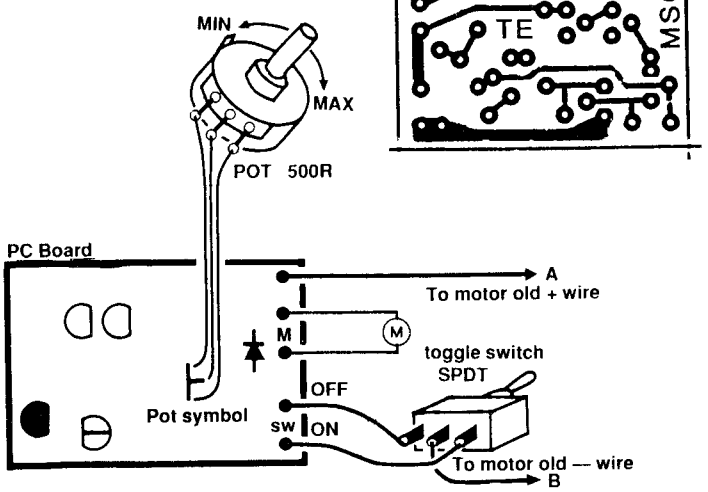
The setting of the speed is determined by a number of factors. The most important of these is the mode of operation. If the tape recorder is to be used in the VOX mode, the tape speed will have to be higher than the lowest setting so that you are sure it will start up every time, under load. This will give an operating time of about 2 - 2.5 hours per side for a C120 cassette.

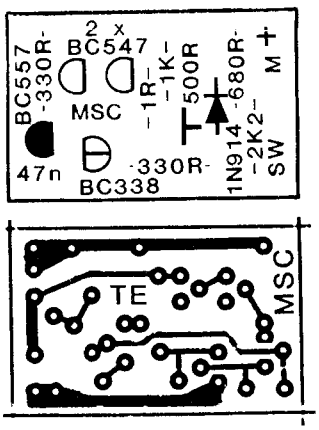
The speed control can be marked 2-3-4 HOURS to give an indication of the running time for the various modes of operation.

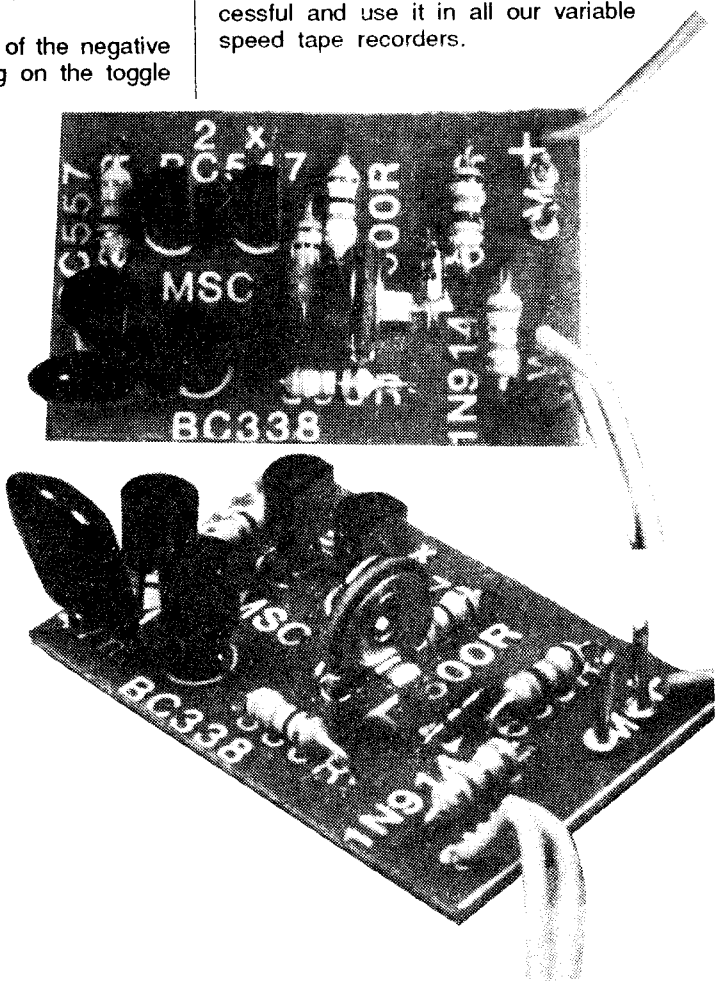
The easiest way to calibrate the control is to make a recording for exactly 1 minute at normal speed. This becomes your reference. Now play the tape at the slower speed and determine how long it takes.

If you are having trouble getting the circuit to work, remember the motor in our prototype was a 6v type @ 150mA. It does not work with a 1.5v motor, so don't try it. The battery voltage must not drop below 6v and if you are using batteries, it is best to have a supply voltage of 7.5v or 9v to allow for the "fall off" in voltage as the cells get older.

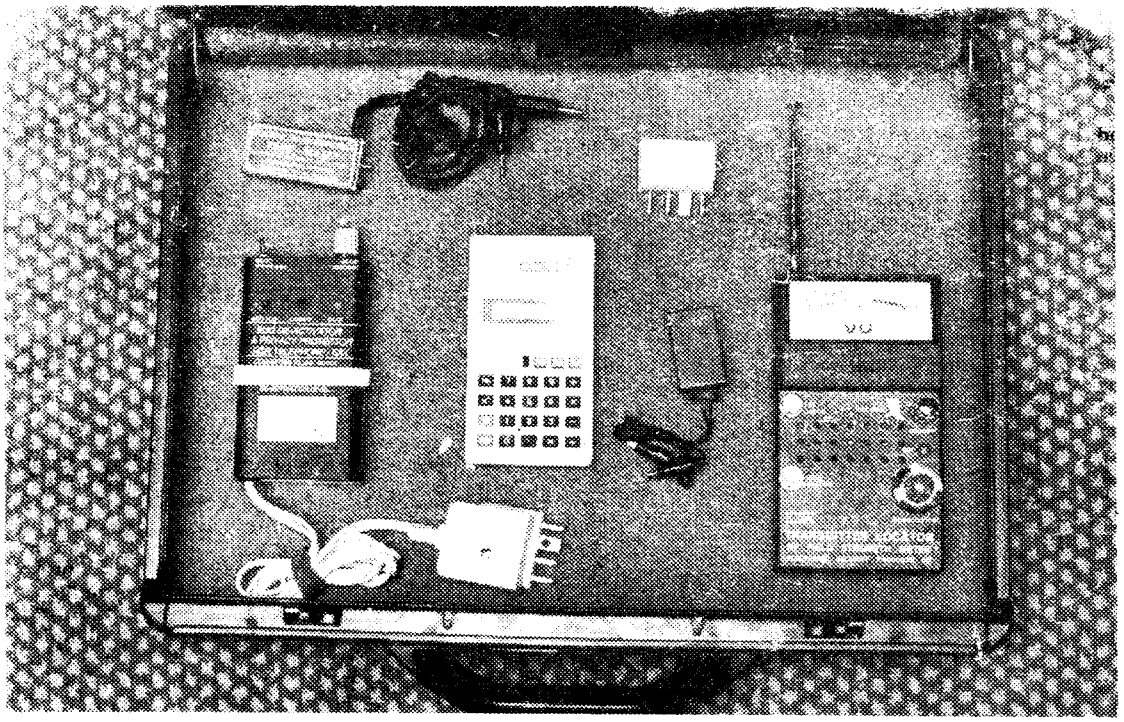
We found the circuit to be most successful and use it in all our variable speed tape recorders.







PC artwork and 2 views of the Motor Speed Controller. The connection diagram shows how it all goes together.



An array of bugs and de-bugging devices readily available in Brisbane. All are legal.

$1600 bug nets a $68,000 windfall

A bugged briefcase left in a boardroom meeting recently saved a Queensland businessman $68,000 on a takeover deal.

The businessman, who bought the Israeli-made briefcase for $1600, was able to monitor the conversation from another room using a receiver in a calculator.

He had activated the bug by changing the combination lock on the case after asking the executives to thrash out a suitable takeover figure.

The businessman later re-entered the meeting and made his bid, considerably below the figure be believed initially it should have been.

Yates Professional Investigations director Julian Yates said the briefcase could be bought legally in Queensland.

He said his company dealt with an expert from TM Security who bought his equipment in Israel which he visited several times a year.

"We act within the law, but some equipment sold in Australia - not by us - is illegal," Mr Yates said.

"We are here to protect against people who bug. We prefer to de-bug, but of course, bugs are sold to people who want to use them legitimately."

Mr Yates said a 1986 report showed Queensland had more illegal bugs uncovered each year than any other state.

He said all manner of bugs could be bought and installed, from a small battery dot listening device stuck to a desk or chair, up to a system worth thousands of dollars hidden in overhead light fittings or even laser bugs, which could be aimed at a window to pick up conversations.

Mr Yates said that for $1,000 an 'infinite' bug could be installed to listen to conversations anywhere in the world.

He said the $1,000 bug was the top of the range and was popular with corporate criminals.

"The bug is connected to the telephone you want to monitor, say for example in a boardroom in Singapore," he said.

"You ring the boardroom shortly before an important meeting and someone answers the phone.

"The caller doesn't even have to speak, the other person hangs up but you don't.

"After 15 seconds, the line will automatically open and you are able to hear within a range of 20 metres - despite the other handset being down."

Nonsense

Mr Yates said TM Security offered a series of listening devices which could be concealed in everyday items such as pictures and ashtrays and could be monitored by ordinary FM radio or telephone.

"Most need no installation expertise at all," he said.

"It is just a matter of plugging them into the telephone line, which takes a second."

Mr Yates said the practice of bugging fascimile machines was going to rise dramatically.

"In a few years this will be big business." he said.

"It is just beginning now and is something people are not aware of.

"Company executives think that because they are not talking on a telephone they are safe, which is utter nonsense.

"They pass so much confidential information down fax machines, which operate on telephone lines, it is unbelievable.

"All people have to do to tap this information is trap and record the fascimile transmission tone, play it back through moding and print the information on their own fax."

sufficient to absorb almost all the signal from a TV transmission.

PC PROTOTYPING

Another letter from a reader asks if we can provide a few details on converting a circuit diagram to a PC layout.

I thought this process was fairly easy to see on our PC boards - especially those like the Ant, Amoeba, Ultima etc where the parts on the board closely follow the circuit diagram.

Most simple circuits lend themselves to this type of layout and it makes testing and servicing very easy.

All you have to do is look at the circuit diagram and place each component in the same relative position on the board. This applies to almost all components except IC's.

When an IC is needed, the approach is different as the pinout doesn't follow the circuit diagram.

For this you will need to use one of our circuit-design aids. This is a matrix board consisting of a grid of holes with a solder land at each hole.

These boards have been designed by us under the name "Designer Boards" and come in sizes 15 x 40, 24 x 25 and 24 x 50.

The components are placed on these boards in exactly the same position as they will appear in the final design and when you come to an IC, you must think for a while and work out which way you want it to be placed on the board.

The connection between lands is done with fine copper wire and when a bridge is required, you must make a link on the top side of the board.

When the layout is finished, tested and perfected, the tinned copper wire will become the copper tracks of the PC board and the links will remain links.

With careful design and maybe moving a few parts, the number of links can be kept to a minimum and quite often no links will be required.

However if you want a circuit to be easily diagnosed you can provide a lot of test links. This is very clever and allows for easy servicing.

Say, for instance, a short occurs in a controller. If the board has a number of test links, the service technician can isolate a section of the board by cutting a link. This way he can progressively "home-in" on the short and when the faulty component is located, he need only resolder the links and the job is done.

Otherwise he has to cut the PC tracks or remove parts and this is very slow and messy.

With printed circuit board manufacturers gradually changing to NC (Numeric Control) drilling and plotting, the only way for a prototype PC board to be made in the near future will be via disk.

To produce the necessary files you will need a computer and CAD package. More will be said about suitable packages at a later date as the package must be able to produce the necessary files for the plotter and drilling machine.

Gone are the days when you can tape-up a board and expect a cheap hand-made prototype to come out the side door of a back-yard PC manufacturer.

Everyone is gearing up for industry requirements for double-sided, plate-through-hole boards. Simple boards are almost a thing of the past.

Don't go by our boards as a pricing guide. Ant boards will cost between $3 - $12 each per hundred plus $60 - $100 for artwork.

Some readers think they can get a "one-off" cheaper than our retail price.

When they hear of a set-up fee of $40 plus $25 for the board they start to keel over.

But that's what it costs to prototype even the simplest board and it's only huge quantities that allows us to keep our prices so low.

This is about as far as we can go in the limited space. May be more next time.

SOLDERING

I know I am going to turn off 99% of readers when I mention the word soldering but I feel it is important to harp on the subject and keep bringing it up until the message gets through.

I have to admit I was not aware of the importance of a good soldering iron until recently. I thought anyone could solder with a rusty nail and get perfect results.

So I dished out cheap junky irons to the workers and expected to get a perfect job. At the end of the first day for a new apprentice I got quite a shock. A batch of 10 Amoebas was less than half done.

I blamed the worker but when he said he'd be faster with a "station," I took a new one out of stock.

Next day he finished the first 10 and had another 10 nearly finished. Granted, he gained experience in soldering but the quality of his work improved too.

It seems the weight of the iron, the flexibility of the lead and the size of the tip play an important part in making a good solder job.

If you have funds available, a soldering iron station is the thing to buy.

Weller is the first choice although the Altronics station (Micron) as it is about half the price. In between we have Scope and Dick Smith. Look at them all before buying.

LATEST NEWS

Ross has perfected a Phone Tape circuit that consists of just 2 components! It's so brilliant that it works with all tape recorders and has absolutely no motor noise or radio interference on the line. But it's so clever that he won't let me publish it.

It's only available ready assembled.

In most cases the made-up device is superior to the kit as our modifications and improvements go into the made-up product but not the kit.

Don't think you are buying the same thing in a kit. The kit is only half as good as the ready-made product. After all, you expect better performance when you're paying more.

CAR TRACKER

The water bug in "Bugging" can be converted into a car tracker by removing the gating diode between pins 6 and 11 of the 74c14. This puts the water detecting circuit out of action and the transistor with its associated components can be left off the board. The electrolytic in the oscillator is changed to 2u2 and the "ON" time resistor (22k) is changed to 47k to give the right length of beep. With these few changes you have a beeper for your car, boat or trailer. The circuit consumes so little power that 3 AAA cells will last for about 3 months.

Two antennas are connected to the board to form a dipole. One wire is connected to the antenna point on the PC and the other connected to the negative rail. When outstretched, they cover about 3 metres and our tests gave a range of about 2kms when detecting the beep from a spotter plane.

If the antenna is placed under the back of a car, the range was limited to about 400 metres.

The efficiency of an antenna under a car is very low and this is why the range is so limited.

Later we are working on a very clever car tracker that gives two outputs, one will be low power and the other high power. This will let you know when you are close to the unit. If only we had some way of detecting when the car turns left or right, we would make a million.

Anyway, it's back to the drawing board and on with the designs for the next book. Until then.

A WORD OF CAUTION

FM transmitters are very powerful devices and ours are intended for fun and education only. You should exercise great care when using them as their range is further than you think.

Always use common sense and abide by the code of ethics that apply to all users of the airwaves.

Obviously these projects are to be used for short periods of time and for harmless broadcasts. It must be pointed out that continued transmission requires a licence no matter how low the power and the use of undesirable language could get you into a lot of hot water. You never know who may be listening and this should be remembered at all times.

Don't leave any of the units on when not required and most of all, don't try putting them atop 10 metre masts! The distance you will cover will be unbelievable.

Remember, the theoretical range for a transmitter has been calculated at 1 million miles per watt, as achieved by a 350 microwatt transmitter reaching a distance of 350 miles!

A COMPARISON

It's nice to know our projects are up in the professional category.

All our designs are equivalent, if not better, than anything else on the market.

We occasionally get the chance to see a professional design, when one is brought into the workshop for repair.

Although some of them are very smart and professionally presented, none have out-performed ours.

When making a comparison, we take two things into account.

Firstly the supply voltage must be the same in both cases as must the current consumption.

The most recent assessment was made on a 9v bug that came in for service. It was about the same size as our Voyager but housed in a neat plastic case. It was more sophisticated than ours and had a class "C" output stage.

When the two were set side-by-side, the RF energy at 10 metres was identical. But the professional bug consumed about 30mA as compared to our 7mA.

This gave the bug a life of about 4 hours on a standard 9v battery or 10-12 hours on an alkaline battery as compared to ours, at 30 hours or more.

Hardly any match!

I am yet to be convinced that a complex circuit can make a unit more stable or transmit further. If I do, I will let you know.

COMPARING

We have received a number of interesting letters from readers asking for modifications to our circuits.

Obviously we cannot spend too much time on individual requests as there is insufficient hours in the day to attend to the tasks at hand!

But when a letter with universal appeal, like that from Mr. S L Maurer of Cambridge, comes along, its reply will assist everyone.

In his letter he included a circuit diagram from another magazine and asks why some of the values are different to those in our circuits.

I have included the circuit below so you can see the differences and follow the discussion.

My reply is not a criticism of the circuit as it doesn't have anything like the performance of our designs and doesn't fall into the same category. It is mainly intended as a hand-held transmitter with a range of about 30metres and reasonably stable performance.

The nearest equivalent is the ANT with a range of 100 metres but it doesn't have quite the stability to classify as a hand-held design.

The first factor that limits the output power of the circuit below is the oscillator coil. It is part of the track-work and as discussed in Bugging, this type of coil has a very low Q factor and thus low output. It is also affected by stray capacitance such as your body or hand and this means the circuit must be operated at very low output power to prevent the frequency drifting when being handled.

Once you are down to this low level the remainder of the circuit becomes non-critical.

However Mr Maurer wants to know why the oscillator transistor has been biased via two 10k resistors and why 330p has been chosen for the base stabilization capacitor.

The function of this capacitor is to keep the base rigid as far as the high frequency is concerned.

You can do this with two 330p or one 660p (connected from base to negative or base to positive, it doesn't matter). The reason is the positive and negative rails are held rigid by the 1n across the battery. (I prefer 22n as this capacitor is very important.)

Instead of 660p you can use 1n or maybe a slightly higher value. But it can't be too high otherwise it will start to affect (attenuate) the audio signal. So a compromise has to be reached.

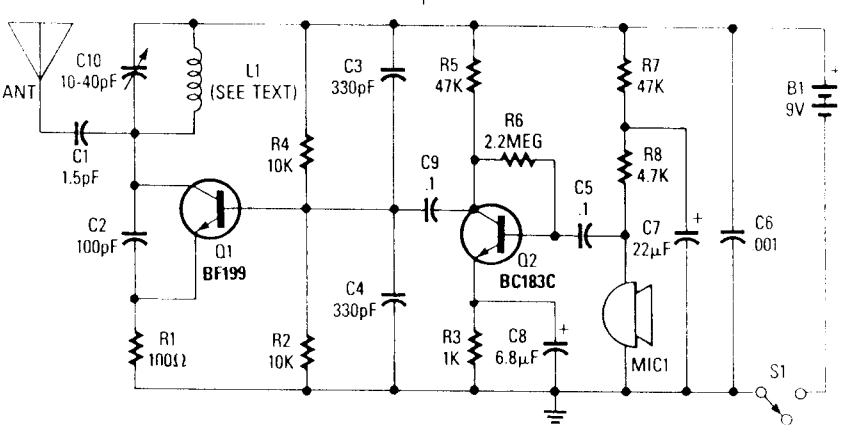
The 100p between collector and emitter is higher than we have used in any of our circuits and is purely a feedback capacitor. It will have a minimal effect on frequency as this is determined by the parallel tuned circuit, made up of the coil and 10-40p trimmer.

The 1p5 take-off capacitor is intended to lightly couple the antenna to the circuit to prevent the circuit drifting when the antenna is touched. This capacitor also has an effect on range as it limits the amount of energy that can be passed to the antenna.

The front end is a typical decoupled arrangement using a 47k and 22u to prevent motorboating (low frequency instability) from occurring.

This is generally only a problem when high stage gain is employed in the front end and we have found that lower values such as 4k7 and 100n will suffice.

The gain of the first stage has been set to about 50 with more gain afforded to high frequencies, via the 6u8 electrolytic in the emitter line.



THE FM-TRANSMITTER circuit has few components, but it can still transmit a clear audio signal up to a hundred feet.

Mr Maurer specifically asks how capacitor values such as 100p and 330p are determined and how these capacitors are "seen" by other components in the circuit.

To answer this we must know the capacitive reactance of a capacitor. In other words we must know its resistance at the frequency we are investigating.

If we assume the circuit is operating at 100MHz, the "resistance" of a 1p capacitor is about 2k. This means a 10p capacitor will be about 200R, a 100p will be about 20R and a 1n capacitor will be 2 ohms!

Thus the 100p capacitor between collector and emitter will appear to the rest of the circuit as a 20 ohm resistor. Likewise the 330p will appear as a 6 ohm resistor and so you can see why we say the base is held very rigid by the pair of 330p's.

FEEDBACK

Recent feedback from a used car salesman says he uses the amoeba fitted into a "clip-board" to improve his sales figures. He leaves the board near the chatting customers and moves to a nearby car and turns on the FM radio.

From there he can listen to their discussion and so clinch the deal more swiftly.

From a second source we heard that a Real Estate agent uses the same technique to sell houses. This is the grey area on which we cannot comment.

If a bug is used to ascertain the integrity of an intending renter, for instance, you can claim it is adding to intelligence gathering but if used to clinch a sale, its legitimacy is questionable.

WATER BUG

Using the Water Bug in reverse.

The Water Bug project in "Bugging and its Prevention" proved to be very popular. It took over from some of the less efficient models on the market, that operated on 27MHz, and found numerous applications on the farm as a security device on gates and outlying sheds etc.

But two constructors requested a reverse application. They wanted to detect the absence of water in a channel and the lowering of water in a tank.

This is quite a serious problem. Sometimes channels that should be carrying water to a field get blocked or the pump fails and this puts the watering program behind.

By simply changing the detector transistor to BC 557, adding a 1M pull-down resistor, changing the 47k tone resistor to 150k as shown in the diagram, the circuit remains de-activated while moisture is present between the probes. When the water level falls, the 1M resistor between base and negative turns the circuit on and the beep will be produced.

You can change the duration and frequency of the beep by altering the 22k and 4u7 to 47k and 2u2.

Enclose the bug as described in the main article and you are ready to detect low water levels.

JUNK COAX

A reader (I cannot find his original letter at the moment) asks if he can connect say 2metres of co-ax to any of the bugs to make the antenna 2 metres higher.

My basic answer is no. We are dealing with very low power (in the order of miliwatts) and coax has a very high loss at 100MHz. Even a 2 metre length will absorb 20% - 90% of the signal unless the coax is very high quality, leaving nothing for radiation.

It is much better to lift the transmitter 2m higher and connect the antenna directly to the output stage.

I know many won't believe me when I say the coax will absorb much of the signal but I can site an example from my TV servicing days that will highlight the point.

It occurred a few years ago but the event is still fresh.

The customer complained of a snowy picture on a 20in Philips colour set.

He had installed the antenna himself, hoping to save money and only because he was a past customer did I accept the job.

I knew the area well and normally the set would work perfectly on rabbits ears. So, when I saw the fault I knew it must be the antenna.

I removed the coax plug from the back of the set and touched the centre of the plug with a screwdriver. The picture was still snowy.

I then opened up the back of the TV and took the cover off the electronic tuner.

I resoldered all the feed-throughs that connect the PC board of the tuner to the mother board of the set.

After this, the screwdriver test showed the picture to be perfect.

But when I boxed the set up and fitted the antenna lead, the picture was still very snowy.

"That's easy," I thought. "The antenna is faulty."

Getting up into the roof is always a struggle and when I reached the antenna I turned it to the correct alignment and added a balun to the coax.

This improved the picture slightly but it was still very poor.

I then fixed up the wall socket but the picture was still not much better.

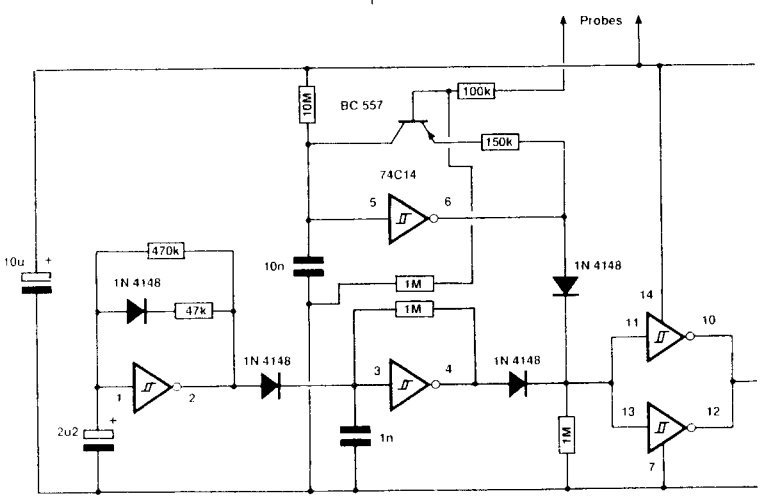
"What could it be?" I thought.

I then placed the screwdriver in the wall end of the fly lead and looked at the picture. Almost total snow.

The 1 metre of lead between set and screwdriver was such poor quality that it absorbed almost all the signal. The lead was one of those cheap, thin, white coax leads as found in some electronics stores located throughout Australia.

They are absolute rubbish and since I didn't have a replacement, all I could do was cut the lead in half and reconnect the plug.

The picture was much better and proves my point that 1 metre of coax is



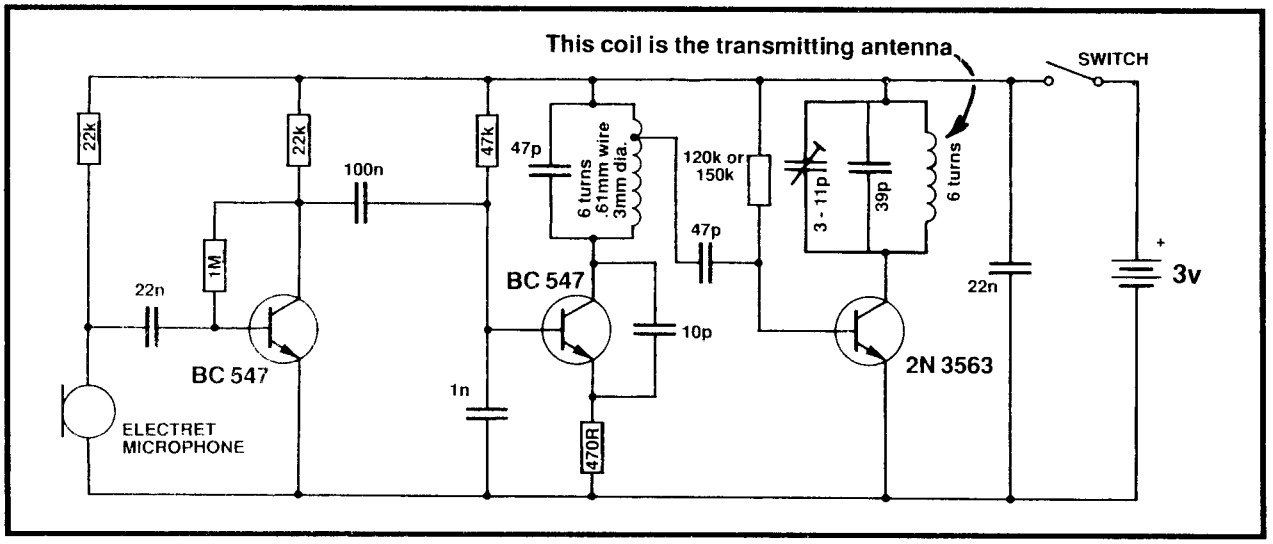
The water Bug circuit modified to detect when water level falls. The altered components are BC 557, 150k & 1M. These components are all near the probes.

PEN BUG Mk II

The Pen Bug improved. . .

Parts $9.50
PC board $2.50
Total: $12.00

The Field Strength Meter project is required to peak this kit.



PEN BUG MkII CIRCUIT

The main problem with the Pen Bug, or any bug that doesn't have a long antenna, is getting an effective range.

Due to the cramped space inside a pen, there is almost no room for an antenna and the range of our original Pen bug was severly limited.

With the modification presented here, you can double the range and maybe get even further.

The modification actually REMOVES the antenna and uses a physically larger tank coil to radiate the signal.

This way the efficiency of the circuit is improved enormously and we don't have any losses, matching the tank circuit to the antenna.

To get the increased range it is important to peak the tank circuit very accurately and to do this you need the Field Strength Meter presented earlier.

When peaking, you can use the method of altering the inductance by squashing the turns but we found this to be too difficult as the capacitance of your fingers upsets the reading.

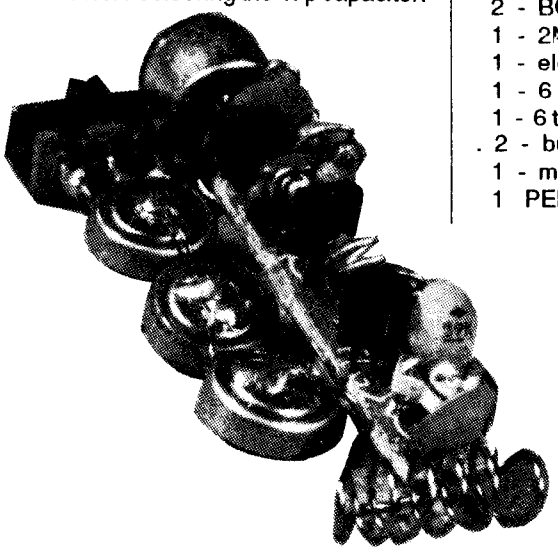
A better approach is to add a 3-11pF air trimmer across a 39p and by turning the trimmer with a non-metallic screwdriver, the circuit will peak easily.

If nothing is detected, you will have to go over the circuit and make sure the oscillator is working (by using the peaking circuit) and tune it to a frequency on the low end of the FM band.

The tank circuit can be initially set up with the peaker, by stretching the turns of the coil. This will give you the broad setting and you can set the trimmer to half-capacitance by referring to our diagram.

Remove the peaker and place the tank coil very near the antenna of the Field Strength Meter. Get the needle to dip as much as you can by squashing the turns of the coil (or pulling them out) and then use the trimmer to get a full dip. You will be amazed at how critical the peaking is.

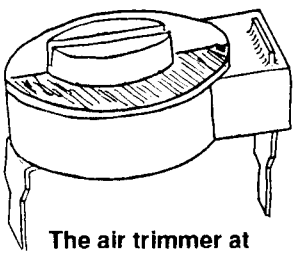
Note: The oscillator coil in the Pen Bug MkII is also made with enamelled wire. This prevents the turns shorting together when fitting the unit in a pen barrel. You must remove the enamel at the 1 turn mark before soldering the 47p capacitor.



The signal from the coil at the front is radiated to the surroundings.

PARTS LIST

1 - 470R 1/4 watt
2 - 22k "
1 - 47k "
1 - 150k "
1 - 1M "
1 - 10p ceramic
1 - 39p " "
2 - 47p " "
1 - 1n " "
2 - 22n " "
1 - 100n monoblock
1 - 3-11pF air trimmer
2 - BC 547 transistors
1 - 2N 3563 RF transistor
1 - electret microphone
1 - 6 turn enamel wire 3mm dia coil
1 - 6 turn enamel wire 4.3mm dia coil
2 - button cells
1 - mini slide switch SPDT
1 PEN BUG PC BOARD



The air trimmer at half capacitance. Turning clockwise will reduce the capacitance as the 'plate' is at the front.

SCORPION Mk II

Cost: $35 incl. parts, PC board, test kit, peaker kit, instructions and post.

What? No circuit diagram? Read the text to find out why.

SCORPION Mk II CIRCUIT DIAGRAM

The complete instructions for this project comes with the kit. We have had to omit the circuit diagram as this is a promotional article and not a constructional article.

SCORPION Mk II is a phone bug that transmits on the FM band and requires no additional power or antenna and operates only when the phone is lifted.

This ingenious device is built on a PC board just .5cm x 1.5cm and clips inside the base of your phone in a matter of seconds.

It must be pointed out the Scorpion Mk II is NOT the same as Scorpion Mk I. The circuit is completely different and it cannot be used with the RF tape recorder, to automatically monitor the phone.

However it will transmit to a nearby FM radio and you can manually tape the conversation.

The frequency of Scorpion MkII can be set to between 70MHz and 110MHz. If you have a de-tuned radio, you can pick the 70-88MHz band and create a "private" channel.

When choosing a frequency is important to keep away from radio stations, couriers and other traffic.

Scorpion MkII can be made tunable by adding a 3-11pF air trimmer on the top of the board and fitting a 47pF underneath. This will give a 4MHz range and to set the band, the number of turns in the oscillator coil is either 7, 8 or 9.

No external antenna is required as the phone line is used for this and will transmit about 50-70 metres, depending on its effectiveness. If it follows an aerial route on poles etc, the range is as quoted. If the line goes underground, the range will be considerably reduced and you may have to use our other transmitter, the SPIDER SP-01.

The Scorpion MkII is very easy to construct and uses only 12 parts to detect both sides of a phone conversation and transmit on the FM band. It is connected in series with one line, via two alligator clips and the circuit adjusts for connection "either way around".

The complete instructions come with the kit and if you have built any any of our other models, you will have no difficulty at all.

Scorpion MkII kit comes complete with a TEST KIT and PEAKER KIT.

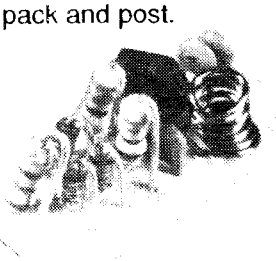
An air trimmer (3-11pF) is also included to allow the frequency to be adjusted as explained in the text.

If you want to use the RF tape recorder to automatically record telephone conversations, the unit to buy is the Scorpion MkI at $90.00. It is a ready-built unit and takes only 10 seconds to install.

The RF tape-recorder (RFT-01) is exclusive to Talking Electronics and records the Scorpion MkI when the phone is lifted.

A special Scorpion MkI is available for electronic phones and for more details on our range of security devices, see the end pages of this issue.

Scorpion MkII kit comes with all components etc. and costs $35 including pack and post.



Scorpion MkII layout

SECURITY DEVICES

The following is a complete list of security devices from Talking Electronics. All items are professional quality and guaranteed to perform as described.
If you are not certain about your requirements, please phone for a discussion.
Don't let the low prices put you off. They are much less than anything else on the market because they have been designed by us and made on our premises. There is no import duty or high mark-up. We make everything we sell.
Our phone number is : (03) 584 2386.

Here is our product range:

BRIEF CASE BUG BC-01 $115 (plus $10.00 post). This is a quality brief case (combination lock type) fitted with a super-sensitive bug, capable of transmitting about 200 metres. The case can be 'left behind' and the resulting conversation picked up in a nearby room or car.

BUG DETECTOR 2000 BD-2000 $150 (plus $5.00 post). Detects transmitting bugs in a room, car, office or telephone. The unit works on the wide-band principle of RF detection. It is switched on & the antenna extended. With a sweeping motion the antenna is probed into all parts of the room. The unit will give a feedback whistle when a bug is detected. The volume control is turned down and a meter on the detector indicates the relative strength of the bug. In this way you can 'home in' on the exact location of any transmitting device.
For phone use: Wind the telephone cord about 4 times around the antenna and place the mouthpiece of the phone to the speaker of the detector. A feedback whistle will indicate any RF bug on the line. The bug will be within 20 metres. Be sure to test every phone as some bugs are designed to operate on one specific extension only.

CAR TRACKING TRANSMITTER CT-02 $65 (plus $5.00 post). This unit fits to the underside of a car with double sided tape and transmits a beep up to 400 metres. Use a directional antenna or standard FM radio to pick up the signal. The unit has very low battery consumption and will last up to three months of continual use.

DOUBLE ADAPTOR BUG DA-01 $105 (plus $5.00 post). This is a transmitting bug, fitted into a double adaptor. It is very easy to install and can be fitted in less than 30 seconds while pretending to make a phone call. Remove the phone plug from the wall, fit the double adaptor and then refit the phone into the top of the adaptor. The bug transmits on the phone line when the phone is in operation and the range depends on the effectiveness of the line as an antenna. 200 metres is average.

INFINITY BUG (SIMPLE TYPE) IBR-00 $100 (plus $5.00 post). This is the simplest version of our popular infinity bug. It is small enough to be placed in the base of the phone and works like this: After making a call the other party hangs up. Instead of hanging up, you whistle down the line and the bug will 'open up.' You will then be able to hear everything that is being said at the other end. Note: This model requires someone at the other end to answer every time you wish to use the bug. Size: 2cm x 3cm x 6cm. Also, all infinity devices must be connected to the line in the room you wish to listen to. You cannot place it on your own line then dial someone else. The bug must be at the other end.

INFINITY BUG RING VERSION IBR-01 $195 (plus $5.00 pack and post). This unit is connected to the phone line and has a super-sensitive microphone and a complex circuit to detect a coded phone ring. It can be installed in a home, office or factory and is ideal for checking on the presence of staff or burglars etc.
It works like this: The unit is connected to the number to be monitored as per the instruction sheet accompanying it and a special note is made of the time intervals required to activate the device.
When you ring the monitored number you must let the phone ring for only one or two rings. At the receiving end, this will sound like a faulty line and anyone near will soon forget. You then hang up and wait an exact number of seconds (as supplied on the instruction sheet), before calling the bug again. This time, when the phone starts to ring, the bug switches on and the bell does not sound at all.
Again you wait until you hear a click on the line. Once you hear the click, whistle down the line and this will open up the bug and let you hear whatever is happening in the room being monitored. The sounds are clearer than if you were in the room and if someone picks up the phone, the bug automatically hangs up. The bug times-out after 5 minutes and can be immediately re-activated by whistling to keep the line open. You can hang up at any time. The bug works on both decadic and DTMF (rotary dial and tone phone systems).
The bug also works in another mode. After making a normal phone call to the bug, the person at the other end will hang up. But you don't hang up. Instead whistle down the line and this will open up the bug and you will be able to hear what goes on after the call has terminated.

INFINITY BUG NO RING VERSION IBNR-01 $330 (plus $5.00 pack and post). Same operation as the ring version, except that while you are accessing the bug, the phone does not ring at all. You can access the bug without anyone at the other end knowing. This unit cancels the ring on both mechanical and electronic phones.

LISTENER LI-01 $75 (plus $5.00 pack and post). The listener enables you to listen in on illegal use of your phone. It will defeat infinity bugs and can be used as an amplifying device for those who are hard of hearing. It also monitors the extension phone to prevent the embarrassment of picking up the main phone when the extension is busy.

PHONE BUG PH-01 $85 (plus $5.00 pack and post). A bug that is disguised as an electronic component. Fits inside the phone and requires soldering in place. Operates the same as the SCORPION, except that the casual observer thinks it is a component of the phone.

PHONE BUG SNIFFER PBS-01 $145 (plus $5.00 pack and post). The Phone Bug Sniffer will detect 3 different types of 'taps' on the line including 'EXTENSION PHONE', 'INFINITY BUG', and 'SERIES LINE BUG.' It requires fitting and INTERNAL ADJUSTMENT before it will operate on a given phone line. It will not detect bugs that are already installed, only if a bug is added after the unit has been installed. (See Bug Detector 2000 for RF bugs on the line.)

PHONE TAP PT-00T $35 (plus $5.00 pack and post). This consists of a tee piece and microphone lead. It is designed for manual operation. The Tee piece plugs into the phone socket and the other end plugs into the MIC input of a tape recorder.

PHONE TAP PT-01 $70 (plus $5.00 pack and post). Comes with 2 alligator clips to be connected to the phone lines (called parallel connection) so that when the handset is picked up, the tape starts. The 2.5mm plug fits into the remote socket and 3.5mm into the MIC socket. The circuit is powered by one AA cell and this will last many months. For the Phone Tape to work, the recorder must have jacks labeled 'REM' and 'MIC'

PHONE TAP PT-01T $80 (plus $5.00 pack and post). Identical to PT-01 except the input lead has a Tee piece for connecting to the phone line. The phone is plugged into the other end of the Tee piece. This unit is easy to install in a matter of moments. Connected in parallel.

PHONE TAP PT-02 $65 (plus $5.00 pack and post). This is a miniature version of PT-01 and requires NO BATTERY. Can be used with any tape recorder having 6v or 9v supply or mains operation. For 3v microcassettes, you must use PT-03. Note: PT-02 does not pick up dial pulses. Connected in parallel.

PHONE TAP PT-03 $50.00 (plus $5.00 pack and post). Crystal clear performance. For all types of tape recorders. Requires No battery. Series connected. For all phones including Commander.

PHONE TAP PT-05 $85 (plus $5.00 pack and post). This unit is similar to PT-01 except it has a timing circuit to limit recording time to the first 5 minutes of a call. (This can be switched off.) This allows you to get at least 12 calls on a C-120 cassette. Connected in parallel.

PHONE TAP PT-05T $95 (plus $5.00 pack and post). Same as PT-05 but with Tee piece for quick connection to the phone line.

RF OPERATED TAPE RECORDER RFT-01 $180 (plus $10.00 pack and post). This tape recorder is designed for use with the SCORPION or VOX bugs. It turns on when it picks up RF transmission. The advantage of this is it can be left unattended and you can catch every event without wasting hours of tape. It will record up to 1 hour of speech and can be placed 50 - 100 metres away, in a convenient location. Comes complete with two C 90 tapes.

RF OPERATED TAPE RECORDER RFT-01S $220 (plus $10.00 pack and post). This unit is the same as the RFT-01 except that it has a special slow-down feature to increase the recording time to over two hours per side of a C 120 tape.

SCORPION SC-01 $90 (plus $5.00 pack and post). This bug is designed to transmit telephone conversations up to 200 metres. It uses the phone line for power and antenna and there are no wires. The transmitting range will vary depending on your telephone installation. If the line is above ground it will be better than if underground. The only way to find out is to buy one and try it. It can be returned for a SPIDER if required. It is fitted in series with one phone wire and comes with full instructions.

SPIDER SP-01 $85 (plus $5.00 pack and post). Identical to the SCORPION, except that it has an antenna for better transmitting range if you have a poor phone line.

SPY BUG 100 SB-100 $85 (plus $5.00 pack and post). A bug the size of two 20¢ coins. Comes with 60cm antenna and is capable of transmitting about 100 metres.

SPY BUG 400 SB-400 $50 (plus $5.00 pack and post). A super sensitive FM bug capable of transmitting 400 metres in a built up area and is fixed at a frequency between 88 and 90MHz. It can pick up sounds such as the ticking of clocks, whispers etc up to 3 metres from the microphone. The size of a Tic tac box and powered by two AAA cells. Will transmit for 200 hours. The batteries are soldered in place for reliability and the unit is returned to us for battery replacement ($6.00) after 200 hours use.

SPY BUG 800 SB-800 $55 (plus $5.00 pack and post). A very small bug that fits on top of a 9v battery and transmits up to 800 metres.

SPY BUG 1000 SB-1000 $65 (plus $5.00 pack and post). This is our most powerful bug. Capable of transmitting 1km in a built up area (Several kilometres in open country) it is the most suitable unit for long distance transmission. This unit is the size of a pack of 25's cigarettes and it uses 4 AAA cells for power. Battery replacement: $8.00 (incl return post) after 100 hours use.

TAPE RECORDER TR-01 $65 (plus $6.00 pack and post). This is a specially modified tape recorder with zero standby current for long battery life. Designed for use with Phone Taps, the unit features AC or DC operation and uses normal tapes. Size 5cm high x 14cm wide x 27cm long.

VOX BUG VOX-01 $75 (plus $5.00 pack and post). This is a voice operated bug that only transmits when it picks up sounds. The battery life is about 3 times longer than normal as it only transmits when sounds are present. It has a very sensitive microphone and an adjustable level control to set the noise level at which the bug will turn on.

VOX MK II VOX-02 $35 (plus $5.00 pack and post). This is a non-transmitting device to switch a tape recorder on and off. Note: this unit does not improve the pick up of the tape recorder, it only switches it on and off.

WALL BUG WB-01 $50 (plus $5.00 pack and post). This unit has the same range as the SPY BUG 400 and is fitted with a vibration detector instead of a microphone. It is designed to be attached to a window with Blu Tack and will listen right through the glass. Also called a SPIKE MIC or CONCRETE BUG it will also listen through walls and doors but the quality is minimal. It is attached to the wall with double sided foam tape and the antenna is held in position with Blu Tack.

This completes our range. All units are fully assembled and tested. They are sold on the understanding that they be used for your own personal safety and surveillance. On no account do we sell these devices for the purposes of intentional bugging. All devices are guaranteed and we can modify certain units for specific applications.

Contact: Talking Electronics,
35 Rosewarne Ave,
Cheltenham, Vic. 3192.
Tel: (03) 584 2386

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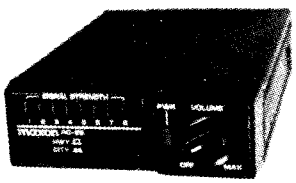
ULTRAPRO MAXON RD-25 RADAR DETECTOR

Two different audio alerts for K and X band
City/Highway Button
Power/Volume with LED indicator and automatic test at power-up
Operating Frequency 10.525 GHz (X-band)
24.150 GHz (K-band)
Power Requirements 11.6v - 16v DC
Negative or positive ground
250mA on standby
430mA on full alarm conditions
Dimensions Approx:- 7.2cm wide
11.5cm long
2.5cm high
Weight 200g



$350.00

Only two left

Warning. Radar detectors are banned from use in some states of Australia.

VIDEO TRANSMITTER

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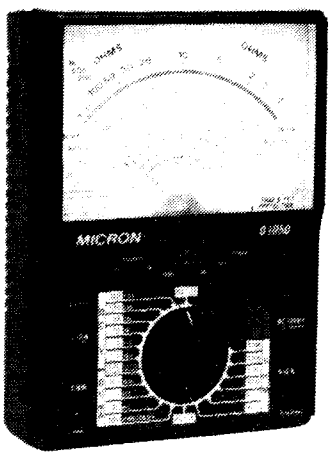
Electronic FET Laboratory Multimeter

Centre Zero Pointer Setting Allows + and - Readings

The Q 1050 breaks new ground for an advanced, prescision analogue meter of this quality below $100. The Q 1050 has the advantage of digital multimeters i.e. significant circuit loading, high accuracy etc. without the misleading and erroneous readings that DVM's are famous for.

• 10 Meg Ohm input • 12 amp DC & AC Current Ranges • Centre zero Pointer Adjust for + and - readings • Single Range & Polarity Reversing switch • Power on LED indicator • P-P calibrated scale.



DC VOLTS
Ranges—0-0.3, 1.2, 12, 30, 120, 300, 1200V; -0-0.15, 0.6, 6, 15, 60, 150, 600V at Centre 0
Input Impedance—Approx 10M Ohm, 3M Ohm at 300mV range
Rated Accuracy—2.5% DC and 3.5% AC full scale on all ranges

AC VOLTS
Ranges—RMS 0-3, 12, 30, 120, 300, 1200V—Peak-peak 0-8, 4, 33, 84, 330, 840, 3300
Input Impedance—Approx. 1M Ohm, 80PF, 2.5M Ohm on 3V Range

Rated Accuracy—50Hz-5MHz +3%—**dB**—+10dB—+63dB at all AC ranges

DC CURRENT
Ranges—0-0.1 uA, 0.3, 3, 30, 300mA, 12A
Potential Drop—300mV Rated Accuracy Within +2.5% full scale all ranges

AC CURRENT
Ranges—0-12A

DC RESISTANCE
Ranges—
RX1 0-1K Ohm
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Rx10K 0-10M Ohm
Rx1M 0-1000M Ohm

Q 1050 $89.95

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Our shop also has the full range of TALKING ELECTRONICS kits and a selection from EA, ETI, and Silicon Chip.

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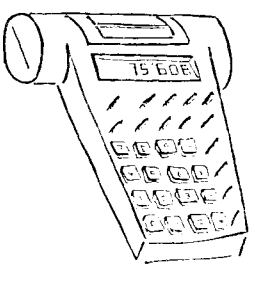
Features auto power off, memory lock function, large display, 38mm normal paper roll. Includes 4 'AA' cells and paper roll. Latest design keys for low entry error.

Normally retails for $99.00

Our Price: $49.00



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Pack of 50 Disks $45.00

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Pack of 10 Disks $25.00

CHEAP DISKS

5 1/4" DSDD NO NAME BRAND
Pack of 10 Disks $6.50

THE MICRO CHIP SAGA

We had hoped that our Phone-Logger project would be ready for this issue. It's an ideal security device for keeping track of the cost of phone calls. But it wasn't to be. Everyone and everything has thwarted us.

The story goes back a while and I'll try to start at the beginning.

For ages we have been asking suppliers to advise us of the most popular processor with onboard ROM and RAM so that we could produce a single chip computer.

From two suppliers we got no response at all, while another tried to promote his antiquated range of chips.

At the time I clutched at straws and followed through with his suggestion to buy a set of books on the chips.

After studying them I went to the supplier to pick up some samples. The most suitable type had onboard EPROM so I needed about 5 to start with.

To my surprise they had exactly ONE!

I then suggested another type and his response was: "We don't have ANY."

After an hour talking with the technical staff I decided this firm was a TOTAL waste of time. Apart from their prices being exhorbitant, stock virtually nil, back-up technical information almost non-existent, their devices were as old as stale cheese.

What I needed was a REAL single chip microprocessor of the latest generation.

My next encounter was also a disaster but the way they lead you on makes a used car salesman look like an amateur.

Lured by a product catalogue, I visited the supplier with high hopes as they listed a full page of single chip CMOS microprocessors.

I settled on a suitable format (ROM, RAM, low current and internal clock) and asked for the price. He opened up the computer and gazed at the display for a while. "We haven't got a price on that one at the moment," he said.

"Oh well, what about this one," I said as I looked through the rest of the range.

Again he looked casually at the monitor and came back with "We don't have a price on that one at the moment either."

"Oh well, what about this next one."

Again the same: "We don't have . . . .

"Oh well, what chips do you have a price on?"

He looked at the screen again and said quite casually: "We don't have a price on any." They're all on indent and have to be ordered from overseas."

I could hardly hold my anger. Why didn't he tell me in the first place? It's no wonder these workers never get any further than serving over a counter. And it's no wonder the supplier never improves its image.

Another 1/2 day wasted and we were no closer to finding our chip.

More months went by and our feelers produced zero.

It seemed such a simple requirement, one which all industry would be searching for.

Then one day, quite out of the blue, I was ordering some chips and a data book on single chip microcontrollers and I again asked the question: "What do you have in stock in the single ship microcontroller field?"

This time I got the answer I wanted. A new range was just being promoted and the cost was well within our budget. We immediately bought a data book and 5 samples.

The tide had turned. At last we had our exact requirements and its capability was the most advanced we had ever seen.

To build a computer identical to the TEC-1 required a total of one chip. The possibilities were really mind-blowing. A TEC for under $100 with a real time clock, LCD display and touch key-pad.

As with anything new, the lack of technical support makes the going very tough at the start.

The setting up of the chip and interfacing took a lot of experimenting and finally we got the chip to talk to the display and the display to respond.

With the two talking, we programmed the words TALKING ELECTRONICS on the display and we were overjoyed.

The next stage was to write a program for the real time clock and since the processor had on-board EPROM, it was necessary to write the program on an external device (such as the TEC) and transfer it to ROM.

The Single Chip Micro (SCM) has a self-programming mode and by making up a simple board with a 1MHz crystal, the chip will transfer the program from ROM and burn it into its internal EPROM.

This takes about 1-2 minutes and by inserting the SCM into its own board, the LCD will be addressed.

Each time you wish to add more program, or change it, the original program has to be erased (15 minutes under the ultra-violet lamp) and re-burnt.

To create programs in this way is not only very time consuming but very costly. You need a handful of SCM's and a lot of fiddling around.

How much more sensible it would be to enable the SCM to access external RAM. In this way you could write a program without ever taking the chip out of the socket. But that's too easy and too cheap. The manufacturer has a trick up his sleeve.

He doesn't want you to be able to program the chip that easily. He want's to sell you a hardware emulation module that aids in programming the chip.

The only trouble is the cost of these boards. They run into nearly $1,000 and need software, disk drive and a PC to support them.

All this comes to around $2,000 to $3,000 and makes the cost of designing the first project very top heavy.

Although the board contains a number of de-bugging features, it is completely out of the question to expect hobbyists or even budding programmers to outlay this amount of money on programming support.

What is required is an alternative path and that's where our clever design team has come up with a solution.

Secretly tucked away inside the chip is a non-user mode that enables the chip to run external RAM and by enabling this mode, programs can be up and running in a fraction of the time.

It seems so absurd to keep this mode hidden from the user (unless the manufacturer wants to sell his support boards!) as the up-front costs are excessive.

If the programmer wants to keep his program safe, he can use another version of the chip that does not have a non-user mode.

Even then, a simple program we have devised will read the program out of both chips an so neither is safe.

The whole problem of keeping software safe is a major concern to designers but just as clever programmers try to keep their labours protected, clever hackers will find a way to access it.

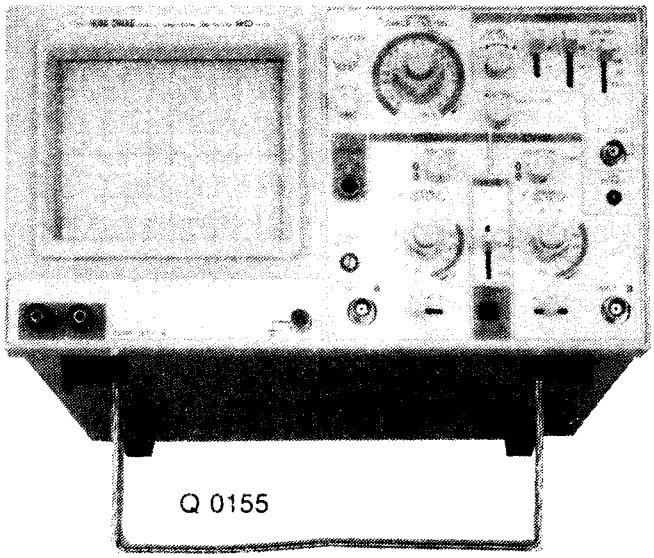
When we decided on this chip we had no idea we were entering the hallowed halls of protection and because we have already spent so much time and money on getting the chip up and running, we will share our gains with you.

This will allow you to enter the field at a fraction of the normal cost. In fact the gates are normally so firmly shut that most of us would have given up a long time ago.

Because of the complexity and delay, we have failed to finish the Phone Logger for this issue. But I know you will be eagerly awaiting our next issue where this and many other impressive ideas will be presented.

I must get back to my new double adaptor "DUAL" bug. It transmits the room sounds when the handset is down and the phone conversation when the handset is lifted. It's amazing. See you in the next issue.

LABTECH or HUNG CHANG
Dual Trace 20MHz CRO With Component Tester



DESCRIPTION:

This model is a dual-trace 20 MHz Oscilloscope using a high brightness CRT. The vertical amplifiers have high sensitivity of 5mV/Div and a frequency characteristic response with smooth roll off exceeding 20MHz. The highest triggering sweep speed is 0.2 usec/Div. For component tests, a special circuit is designed, with which a single component or components in or out of actual circuit board can be easily tested, requiring no power to drive the circuit. The display shows fault of component value, characteristics of component, and half-dead components under dynamic test.

FEATURES:

• Component Tester • Wide bandwidth and high sensitivity • Very low power consumption • High sensitivity X-Y mode • Z axis (intensity modulation) • Front panel electrical trace Rotator • Regulated power supply circuit for Accuracy.

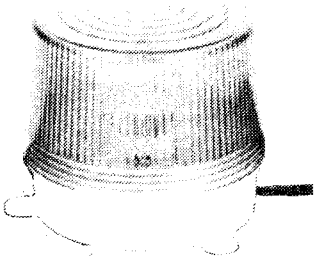
Comes with two sets of probes and posted FREE ! anywhere in Australia.

Unbeatable Value! **$799.00**

Strobe Signal Lamps

Uses Xenon Strobe tube for High energy strobe flash output at a rate approx. 1 per second.

Fantastic light energy output for the DC power used. DC input 12V 320mA.



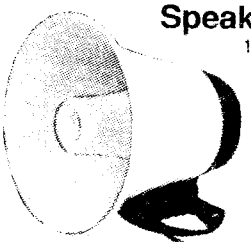
Dimensions 97 diam. 90H
Two Colours Available

S 5455 Blue **$27.50**
10 Up **$26.00**

S 5450 Red **$27.50**
10 Up **$26.00**

Weatherproof Horn Speakers

10 Watt



C 2015 **$15.95**
10 Up **$14.80**

TIP 3055	$1.00
5 x 4072 IC	$1.00
LM 311	$1.00
TIP 31	$1.00
TIP 32	$1.00
CM 1004	
10A 400v BRIDGE	$2.50

12v TEST PROBE

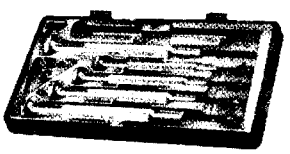
Useful for testing the electrical system in 12v automobiles. No home mechanic should be without one.

$2.50

PRECISION SCREWDRIVER SET

6 piece set, including two phillips heads and 4 flat heads.

$3.50



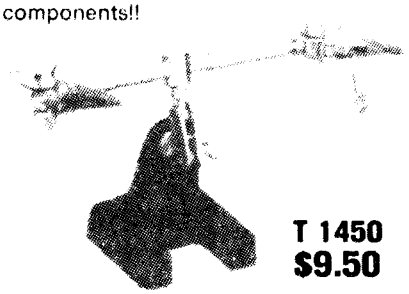
Probe Sets

1:1 or 10:1 Attenuation

Q 0175 **$49.95**

PCB Stand With Alligator Clips

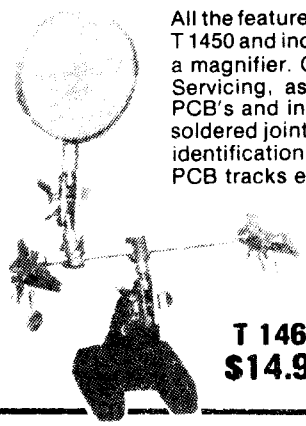
Screw this handy little jig to your work bench and presto! you now have both hands free to insert and solder components!!



T 1450
$9.50

PCB Stand With Magnifier

All the features of the T 1450 and including a magnifier. Great for Servicing, assembling PCB's and inspecting soldered joints, component identification, cracks in PCB tracks etc.



T 1460
$14.95

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Coming soon! A bug detector with memory!
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SECURITY DEVICES PRICE LIST

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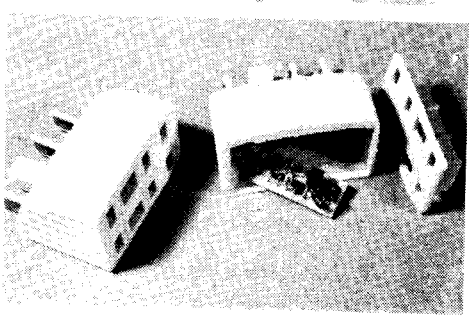
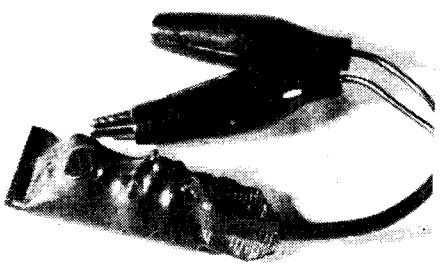
BD-2000	Bug Detector locates transmitting bugs. 20-200 MHz	150
CT-02	Car tracker version 2 beep only, range 400m	65
DA-01	Double Adaptor bug. A scorpion in a Double Adaptor.	105
IBR-00	Infinity bug simple. Listen after other party hangs up	100
IBR-01	Infinity bug, coded auto answer. Ring version.	195
IBNR-02	Infinity bug, coded auto answer, No ring version.	330
LI-01	Listener. Phone amplifier for the hearing impaired	75
PBS-01	Phone bug sniffer. Detects bugs on telephone line.	145
PH-01	Phone bug disguised as a capacitor. Requires soldering.	85
PT-00	Phone tap for sound only, no motor on/off switch.	35
PT-01	Standard phone tap with motor control	70
PT-01T	Standard phone tap with motor control, Tee piece.	80
PT-02	Phone tap with motor control, no battery required.	65
PT-02T	Phone tap with motor control, no battery, Tee piece.	75
PT-03	Phone tap for 3v tape recorders, no batt needed	50
PT-03T	As above, with Tee piece.	60
PT-03M	Phone tap for microcassette recorders. Has 3v batt	55
PT-05	Phone tap, records 1st 5 minutes of each call.	85
PT-05T	Phone tap, records 1st 5 minutes of each call, Tee piece.	95
PR-01	RQ-2104 National tape deck, A.C. powered.	70
PO-01	M-1115 VOX tape deck, with remote socket	150
RO-02	Micro-18 micro cassette recorder.	110
RFT-01	RF Operated tape recorder.	180
RFT-01S	RF Operated tape recorder with motor speed control.	220
SC-01	Scorpion phone transmitter	90
SC-02	SC-01, with 4 pin U.S. plug for electronic phones.	100
SP-01	SC-01, with antenna for better range in poor areas.	85
SB-100	Spy Bug 100metre room transmitter.	85
SB-400	400metre room transmitter	50
SB-800	800 metre room transmitter	55
SB-1000	1km room transmitter	65
TR-01	'International' AC/DC tape deck for phone taps	65
VOX-01	Transmitting VOX bug.	75
VOX-01B	Transmitting VOX in-a-box, with telescopic antenna.	95
VOX-02	VOX MkII. Turns any tape recorder into voice operated	35
WB-01	Wall bug. 400m transmitter that listens through glass etc.	50





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A 240v mains powered bug in a new-style double-adaptor. $140.00

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MINI TRIM POTS 50c

CAPACITORS

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5p6	.15
10p	.15
18p	.15
27p	.15
47p	.15
56p	.15
100p	.15
220p	.15
330p	.15
1n	.15
22n	.15
33n	.15

GREENCAPS

1n	.25
2n2	.25
3n3	.25
3n9	.25
4n7	.25
6n8	.25
10n	.25
22n	.25
33n	.25
39n	.25
47n	.28
100n greencap	.30
100n monoblock	.35
220n monoblock	.55
Air Trimmer 5-40p	.70

ELECTROLYTICS

1u	63v	27c
2u2	16v	27c
3u3	16v	27c
4u7	16v	27c
10u	16v	27c
22u	16v	27c
47u	16v	30c
100u	16v	45c
220u	25v	60c
220u	63v	75c
470u	25v	70c
100u	25v	85c
1000u	63v	1.70
2200u	25v	2.00

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7400	.80
74LS04	.75
74LS11	.75
7420	.90
74LS73	.70
74LS74	1.00
7476	1.10
74LS123	1.30
74LS138	1.50
74LS273	2.25
74LS367	1.25
74LS373	2.25

CMOS

4001	70c
4011	70c
4013	90c
4015	1.45
4017	1.50
4020	1.80
4024	1.30
4026	2.60
4040	1.80
4046	2.10
4047	2.10
4049	2.00
4051	1.90
4060	2.60
4069	80c
4071	75c
4510	2.10
4511	2.10
4514	5.60
4518	1.90
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8255	7.50
2114	5.00
6116(58725)	7.95
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7905	1.90
7812	1.20
7815	1.20
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16 pin	45c
18 pin	45c
20 pin	50c
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40 pin	95c

Surface Mount Resistor packs. 60 Resistors. 2 off each value 10R to 1M $12.00

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1N 4002	.15
1N 5404	.30
IFR Z40 (BUZ 11)	5.00
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BC 557	.25
BC 338	.30
BD 139	.80
BD 140	.80
2N 3563	.90
2N 3055	1.50
TIP 31	1.00
TIP 32	1.00

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3mm RED LED	.18
3mm GREEN LED	.30
3mm ORANGE LED	.30
3mm YELLOW LED	.30
5mm RED LED	.20
5mm GREEN LED	.30
5mm ORANGE LED	.30
5mm YELLOW LED	.30
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16 Char by 2 line LCD	39.00

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2 1/4" speaker 8R	2.30
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Large piezo	2.95
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DPDT relay 3 amp rating	3.15
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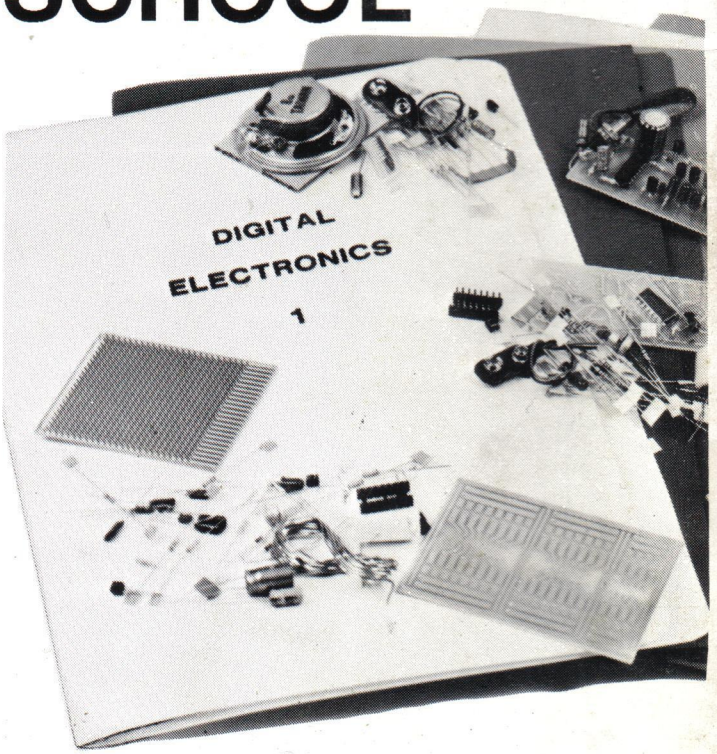

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